

# ELECTRONIC DESIGN

SEPTEMBER 13, 1956

B 611929

SEP 26 1956



**NEW**  
from  
**IRC!**



## Superior Power Resistor Features in a Low Cost 5-Watt Unit

The new IRC PW-5 Wire Wound Resistor now opens up new possibilities for miniaturization and cost savings in resistance capacitance filters, radio and TV circuits, bridge circuits, attenuator networks, and many other circuits. With this new 5-watt resistor, you can now obtain the superior insulating and high temperature characteristics as

found in IRC's famous PW-7 and PW-10 units. The PW-5 also offers you the same extra terminal security resulting from simultaneous assembly of element, leads, and terminal clips in one automatic operation. This latest addition means that you now can specify IRC for *all* medium power requirements.

### LOOK AT THESE FEATURES

- PW-5 saves space ... only  $\frac{7}{8}$ " x  $\frac{3}{8}$ " x  $\frac{1}{2}$ "
- PW-5 covers wide range ... from 0.24 ohm to 3300 ohms
- PW-5 installs easily ... rectangular case with axial leads
- PW-5 stands high temperatures ... operates at 60% rated load even at 100° C. ambient

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Dept. 266, 401 N. Broad St., Phila. 8, Pa.

*In Canada: International Resistance Co., Ltd., Toronto, Licensee*

Send bulletin describing new 5-Watt, 7-Watt, and 10-Watt Power Resistors.

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# ELECTRONIC DESIGN

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BPA



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There are many thermal time delay applications for which the high cost of hermetic sealing is unnecessary, but where long life and complete reliability are vital. The new G-V Red Dot is made for these jobs. At half the cost of the well known G-V Hermetically Sealed Thermal Relays you get —

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Request publication 120 for complete data and prices.



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Items below and 650 others in our catalog A.

## HERMETIC SUB-MINIATURE AUDIO UNITS

These are the smallest hermetic audios made.

Dimensions ... 1/2 x 11/16 x 29/32 ... Weight .8 oz.



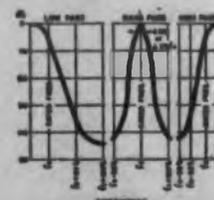
### TYPICAL ITEMS

Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	DC In Pri MA	Response $\pm 2$ db (Cyc.)	Max. level dbm
H-30	Input to grid	TF1A10YY	50*	62,500	0	150-10,000	+13
H-31	Single plate to single grid, 3:1	TF1A15YY	10,000	90,000	0	300-10,000	+13
H-32	Single plate to line	TF1A13YY	10,000*	200	3	300-10,000	+13
H-33	Single plate to low impedance	TF1A13YY	30,000	50	1	300-10,000	+15
H-34	Single plate to low impedance	TF1A13YY	100,000	60	.5	300-10,000	+6
H-35	Reactor	TF1A20YY	100 Henries-0 DC, 50 Henries-1 Ma. DC,	4,400 ohms.			
H-36	Transistor Interstage	TF1A15YY	25,000	1,000	.5	300-10,000	+10

\*Can be used with higher source impedances, with corresponding reduction in frequency range and current

## COMPACT HERMETIC AUDIO FILTERS

UTC standardized filters are for low pass, high pass, and band pass application in both inter-stage and line impedance designs. Thirty four stock values, others to order. Case 1-3/16 x 1-11/16 x 1-5/8—2-1/2 high ... Weight 6-9 oz.



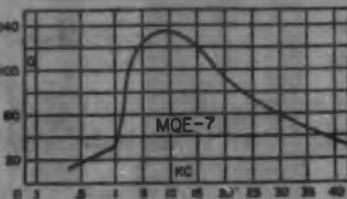
## HERMETIC MINIATURE HI-Q TOROIDS

MQE units provide high Q, excellent stability and minimum hum pickup in a case only. 1/2 x 1-1/16 x 17/32 ... weight 1.5 oz.



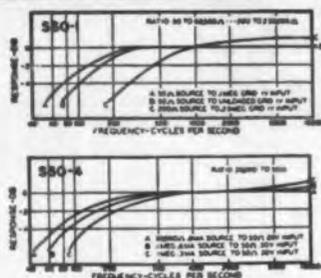
### TYPICAL ITEMS

Type No.	Inductance	DC Max.
MQE-1	7 mhy.	135
MQE-3	20 mhy.	80
MQE-5	50 mhy.	50
MQE-7	100 mhy.	35
MQE-10	.4 hy.	17
MQE-12	.8 hy.	12
MQE-15	2.8 hy.	7.2



## SUB-SUBOUNCER AUDIO UNITS

UTC Subouncer and sub-subouncer units provide exceptional efficiency and frequency range in miniature size. Constructional details assure maximum reliability. SSO units are 7/16 x 3/4 x 43/64 ... Weight 1/50 lb.



Type	Application	Level	Pri. Imp.	MA D.C. in Pri.	Sec. Imp.	Pri. Res.	Sec. Res.
*SSO-1	Input	+4 V.U.	200 50	0	250,000 62,500	13.5	3700
SSO-2	Interstage /3:1	+4 V.U.	10,000	0-.25	90,000	750	3250
*SSO-3	Plate to Line	+20 V.U.	10,000 25,000	3 1.5	200 500	2600	35
SSO-4	Output	+20 V.U.	30,000	1.0	50	2875	4.6
SSO-5	Reactor 50 HY at 1 mil. D.C. 4400 ohms D.C. Res.						
SSO-6	Output	+20 V.U.	100,000	.5	60	4700	3.3
*SSO-7	Transistor Interstage	+10 V.U.	20,000 30,000	.5 .5	800 1,200	850	125

\* Impedance ratio is fixed, 1250:1 for SSO-1, 1:50 for SSO-3. Any impedance between the values shown may be employed.

## SUB-SUBOUNCER (WIDE RANGE) AUDIO UNITS

Standard for the industry for 15 yrs., these units provide 30-20,000 cycle response in a case 7/8 dia. x 1-3/16 high. Weight 1 oz.

### TYPICAL ITEMS

Type No.	Application	Pri. Imp	Sec. Imp
0-1	Mike, pickup or line to 1 grid	50, 200/250, 500/600	50,000
0-4	Single plate to 1 grid	15,000	60,000
0-7	Single plate to 2 grids, D.C. in Pri.	15,000	95,000
0-9	Single plate to line, D.C. in Pri.	15,000	50, 200/250, 500/600
0-10	Push pull plates to line	30,000 ohms plate to plate	50, 200/250, 500/600
0-12	Mixing and matching	50, 200/250	50, 200/250, 500/600
0-13	Reactor, 300 Hys.—no D.C.; 50 Hys.—3 MA. D.C., 6000 ohms		

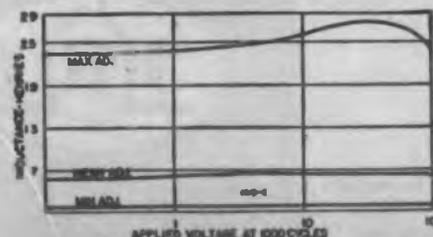
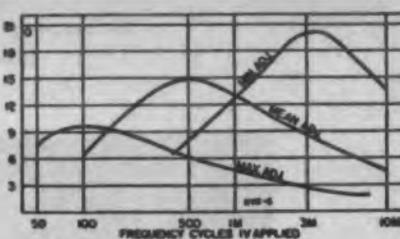
## HERMETIC VARIABLE INDUCTORS



These inductors provide high Q from 50-10,000 cycles with exceptional stability. Wide inductance range (10-1) in an extremely compact case 25/32 x 1-1/8 x 1-3/16 ... Weight 2 oz.

### TYPICAL ITEMS

TYPE No.	Min. Hys.	Mean Hys.	Max. Hys.	DC Ma
HVC-1	.002	.006	.02	100
HVC-3	.011	.040	.11	40
HVC-5	.07	.25	.7	20
HVC-6	.2	.6	2	15
HVC-10	7.0	25	70	3.5
HVC-12	50	150	500	1.5



## Editorial

### How Big Can Shows Get?

Having just returned foot-weary from the largest electronics show and convention ever held on the West Coast and with the last New York IRE and Chicago NEC show fatigue still vividly in mind, it seems appropriate to ask the question: "How big can a show get?"

There must be a limit. Yet, no limit is in sight on the growth of the mushrooming electronics industry. At the same time, we are rapidly outgrowing facilities available to handle them. Already it is expected that New York's new gigantic Coliseum will be too small to house all prospective exhibitors in next March's IRE Show. Few cities now have sufficient hotel facilities for such shows as IRE and WESCON.

One show official has proposed that exhibitors deploy their show efforts and exhibit at regional shows, rather than always at the "big" ones. Though this might solve the exhibit manager's problems, we doubt the popularity of this suggestion with exhibitors, show visitors, or executives. Exhibitors feel that big shows offer the greatest return for money expended. Visitors and executives cannot be expected to attend numerous shows all over the country each year.

Holding individual shows based on IRE Professional Group interest seems to make some sense as far as technical sessions are concerned. But since the components and equipment usually overlap many Professional Group interests, exhibitors would be burdened with added shows at which to exhibit without any appreciable increase in sales.

The solution to the problem is not a simple one. We propose the formation of an all-electronic industry-IRE committee to make a careful study of the problem and endeavor to find a suitable solution while there is still time to avoid total self-destruction of the "giant." How big can a show get? We must find an answer, and soon.

## UNITED TRANSFORMER CO.

150 Varick Street, New York 13, N. Y. • EXPORT DIVISION, 13 E. 40th St., New York 16, N. Y.

◀ CIRCLE 3 ON READER-SERVICE CARD

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# Electronic News

For more information on developments described in "Electronic News", write directly to the address given in the individual item.

## One Man Portable TV "Station"

Spot news and other field pickup functions can be telecast with a *transistorized* 4-pound camera and a 15-pound transmitter developed by RCA's David Sarnoff Research Center in Princeton, New Jersey.

The camera is built around an RCA 1/2 in. Vidicon pickup tube and features an electronic view-finder which can be detached from the camera and hung or strapped around the cameraman's neck and shoulders. Electronically synchronized with the camera, the finder indicates what the camera "sees", even when the camera and its finder are separated physically.

The camera may be hand-held or tripod supported, while the view finder may be separated from the camera and viewed like a reflex camera.

The 2000 mc transmitter operates in the band of frequencies approved by the FCC for this type of operation. The transmitter can be back-packed by one man and is placed in the metal container which also houses a synchronizing generator and battery supply. The transmitter utilized a cavity stabilized triode oscillator. With a power output of 0.5 w, TV signals can be received by a directive antenna at a base station more than a mile away.

The silver cell batteries contained in the 15 pound pack operate the equipment for 5 hours and can be recharged.

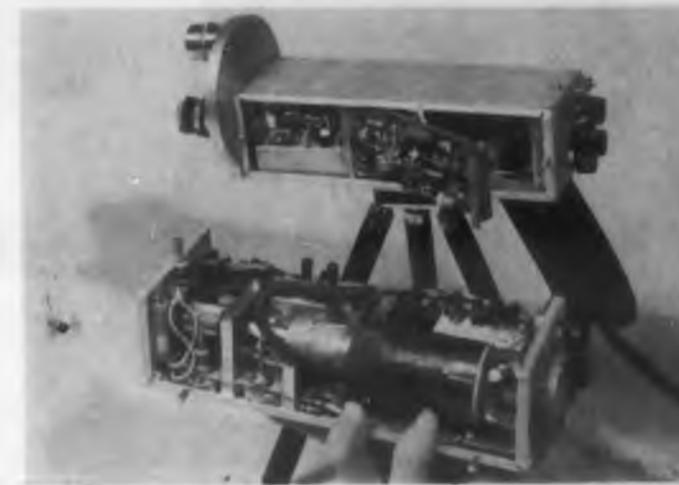
Seventy transistors and one transmitter tube, in addition to the pickup and view finder tube, are used.



## Electronic Eye Aids Blind PBX Operators

Without modifying existing equipment, an electronic "eye" permits the blind to operate private telephone switchboards. Developed by Bell Telephone Labs., this tiny, thimble-like, light-sensitive phototransistor weighs less than 1 oz.

Heretofore, when a call came into the switchboard, a signal sounded and a lamp lighted. The operator, then, simply plugged a cord into the jack associated with the glowing lamp. A blind operator can now listen for the incoming call signal, and run her finger, which has the "eye" attached to it, across the horizontal row of lights. Upon reaching the lighted lamp, the phototransistor is activated and the operator hears a signal in her headset. The cord which she holds is plugged into the jack associated with the illuminated lamp, thus completing the connection. The operator then determines the extension to which the call is to be made; she picks up another cord paired with the first one and plugs it in to ring the desired extension. The operator knows the location of the extension jacks through familiarity with the switchboard.



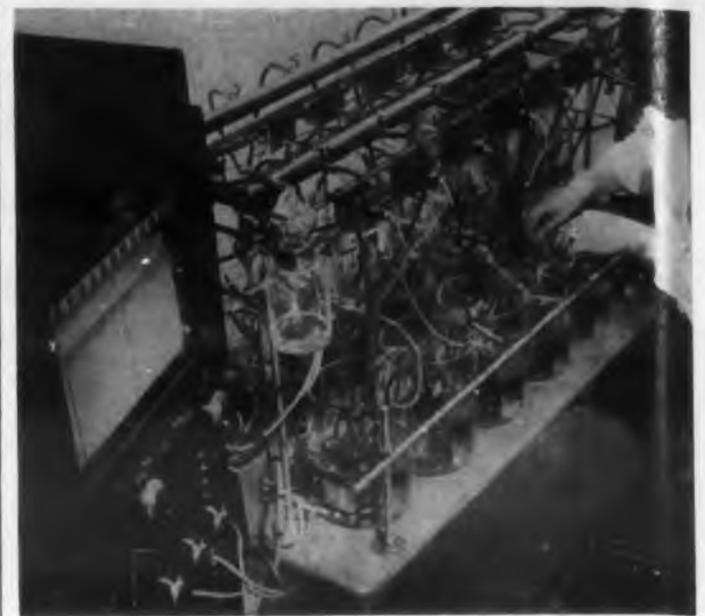
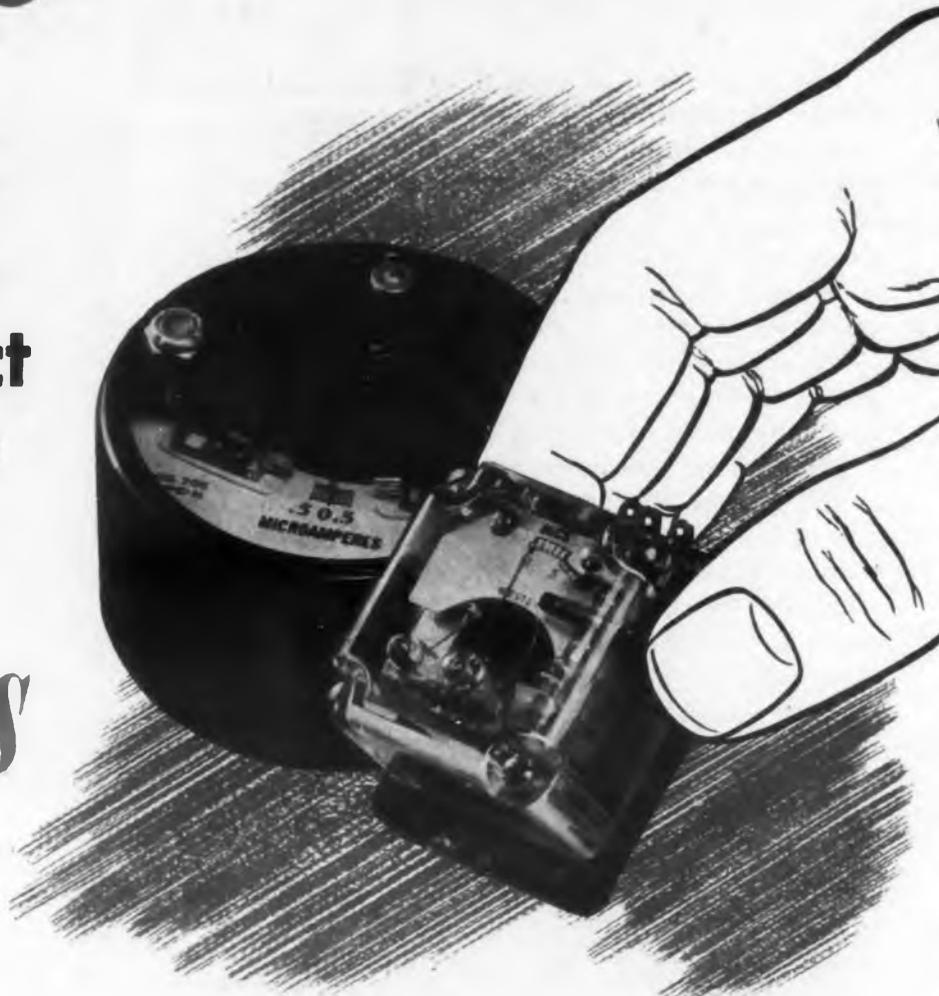
# Forget the Amplifier

If your design utilizes an amplifier to boost a minute signal for relay operation — or, if you have 'shelved' some new product idea because the cost, space requirement and other drawbacks of amplifiers made the design impractical — *Sensitrol relays are for you.* For these tiny, ultra-sensitive relays, which operate direct on input signals as slight as 1 millivolt or ½ microampere, and handle substantial wattage at 110 volts, entirely replace amplifiers, vacuum tubes and auxiliary power supplies. They are available with single or double contacts, fixed or adjustable, manual or solenoid reset. For engineering assistance in adapting Sensitrol relays to present products, or new problems you have in mind, call your nearest Weston representative, or write for the Sensitrol bulletin B-25-B . . . *Weston Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N. J.*

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input signals  
with compact

*Sensitrol*<sup>®</sup>  
ultra-sensitive *relays*

**WESTON** Instruments



#### Produce Electricity From Gases

The "fuel cell," a battery to produce electricity from such gases as hydrogen and oxygen, is presently under study at the Basic Research Labs., National Carbon Co., Parma, Ohio.

The unit would consist of 2 basic unit sections. One section has 2 layers of porous carbon spaced between liquid-paste caustic solution. Oxygen would stream through the space and the molecules would move through the submicroscopic areas in the porous carbon. When the molecules reach the caustic layer, they form a film. Reactions take place which produce negatively charged particles. This is the electron-consuming or "positive" section of the battery. Hydrogen, in a similar way, is used to produce positively charged particles for the "negative" section of the battery.

#### More nickel to industry

Office of Defense Mobilization has ordered 40,000,000 more pounds of nickel be diverted from Govt to industry in 3rd & 4th quarters of this year. The diversion, said ODM director Arthur S. Flemming, will give non-defense consumers more nickel than they obtained during any 1955 quarter or the first quarter of this year.

#### Computer Solves Problems By Remote Control

Dr. E. L. Harder, director of engineering and service analytical department at Westinghouse Electric Corp., Pittsburgh, indicates that their IBM 704 computer has been already used to calculate atomic reactor power problems, to determine stresses in generator shafts, and to design turbine generators.

By telephone or telegraph, Westinghouse plants in other cities are able to utilize this computer by use of a new "data transceiver." Punch card operated, a private communications network is set up whereby transceiver units link their installation with the centrally located computer.

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### Mass Production of New Transistors

Two new types of transistors, a Micro-Alloy Transistor (MAT) and a Surface-Barrier Diffused Transistor (SBDT), are the direct result of a new manufacturing technique. Developed at Philco's Research Labs, the new devices will be produced by a division of Philco, the Lansdale Tube Co., Spring City, Pa.

The new process avoids the necessity of manually assembling the germanium and the electrode material and alloying them in a furnace. The MAT process uses doped semiconductor layers, only a few millionths of an inch thick and is intended for high speed computer work. The SBDT process subjects tiny germanium transistor blanks to a very carefully controlled atmosphere of metal particles in gaseous form at high temperature. Atoms of the metal, when properly controlled, penetrate the surface of the germanium by diffusion. These latter transistors operate in the uhf range of 500 mc, with a widest use in the 20 to 200 mc range.

### Air Safety & Electronics

Focus of public and Govt attention is being directed at electronics with perhaps greatest intensity in industry's history—as all responsible officials seek techniques for preventing recurrence of such disasters as recent 2-plane collision over Grand Canyon. As of this writing, near end of Congress' session, President Eisenhower has asked appropriation of an extra \$68,043,000 so that Civil Aeronautics Authority can speed air-traffic improvements in anticipation of the even greater needs of jet aircraft. Funds would be in addition to the \$40,000,000 already appropriated for that purpose. President's request is part of 5-year plan outlined to Congress earlier this year; it anticipated expenditures of \$246,000,000 over the period. Now, however, Secy of Commerce Sinclair Weeks hopes to condense the program into 3 years. If the shocked gravity of Congress is any criterion, Administration will get almost carte blanche to do anything to promote air safety. . . . Meanwhile, CAA announced it will study how military's SAGE system of air defense can be integrated with civilian air traffic control to promote efficiency. Study will be conducted by a military integration branch of CAA's Technical Development Center in Boston area. . . . Among latest devices aimed at improving air traffic control is Stromberg-Carlson's commercial version of Charactron shaped-beam tube which has been employed in SAGE. The moving diagram provided by the Charactron is exceedingly clear. In addition to indicating the relative positions of the aircraft, and showing movement across a map-diagram, the system actually prints letters and numbers to represent such information as flight number of the plane, speed and altitude.



### RESEARCH

Solid state devices for not-so-distant future applications command continuous study by Tung-Sol engineers. In this instance the purifying of silicon is under close scrutiny.



### DESIGN

Efficiency and utility are among the foremost considerations of all Tung-Sol semiconductor blue-printing. Here the resistivity of single germanium crystals is being measured.



### DEVELOPMENT

Ever alert to the intensified and varied demands made by transistorizing, Tung-Sol provides full-scale development of new semiconductor types. Here the latest techniques of germanium diffusion are explored.

## New Production Facilities for Tung-Sol Semiconductors



### TESTING

100% testing—life, mechanical and electrical—characterizes the Tung-Sol manufacturing program. In this illustration, transistors are 100% checked for noise factor.



### QUALITY CONTROL

Every step of Tung-Sol semiconductor manufacture is subjected to intensive quality control that permits no compromise with premium quality. Here transistors are life-tested under conditions in excess of their ratings.

### PRODUCTION

A complete manufacturing division—with its own full-time engineering and management staffs—handles every phase of the critical production process from metal refining to finished product. Here germanium ingots are being sliced into 15/1000" blanks.



**TUNG-SOL**  
SEMICONDUCTORS



For technical information write to Commercial Engineering Division

**TUNG-SOL ELECTRIC INC., Newark 4, N. J.**

SALES OFFICES: ATLANTA, COLUMBUS, CULVER CITY, DALLAS, DENVER, DETROIT, MELROSE PARK (ILL.), NEWARK, SEATTLE



Miniature Lamps



Sealed Beam Headlamps



Signal Flashers



Radio And TV Tubes



Aluminized Picture Tubes



Special Purpose Tubes



Semiconductors



Color Picture Tubes

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*A good product... made even better  
... with plastics parts by G.E.*



Coil form and mount used in two-way radio, molded by G.E.'s Plastics Department to exacting tolerances. Note how metal inserts are molded right into the mount — threaded afterwards to insure clean contacts.

**LOOKING FOR PRECISION-MOLDED PLASTICS PARTS?** Perhaps this example from General Electric's Plastics Department will help you. Molded for the G-E two-way radio, this coil form and mount require exacting tolerances, since they determine the accuracy with which other components fit into the assembly. In addition, they must resist arcs and high heat. G-E Plastics Department engineers selected a mineral-filled phenolic with good dimensional stability and excellent dielectric strength. They then molded the parts to the exact dimensions required, assuring quick, accurate assembly. Metal in-

serts were molded in, threaded afterwards, to insure clean contacts.

**Where can YOU use plastics parts by G.E. to make a good product even better?** If you are contemplating a new product, or are looking for a way to improve a present one, keep plastics in mind! As one of the world's foremost custom-molders, General Electric has helped scores of manufacturers improve product performance and appearance, realize important cost savings. G.E.'s custom-molding service will be happy to help you in engineering and developing your products—through plastics.

Write today on your company letterhead for a free copy of "The G-E Plastics Story," containing stimulating case histories of how customers profit through plastics. Just write: Plastics Department, General Electric Company, Section 6X6A1, Decatur, Ill.



*Progress Is Our Most Important Product*  
**GENERAL ELECTRIC**

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#### Isolation For Acoustics

A new anechoic chamber for research and testing in all phases of acoustics has been completed by Stromberg-Carlson, Rochester, New York.

This facility, designed to exclude all exterior sounds and to eliminate internal acoustic reflections or echoes, will be used for the design, development and quality control studies of high fidelity audio equipment.

Since the chamber stands less than 50 ft from the main line of a railroad, and is close to a heavily-traveled city street, it was necessary to construct a "room within a room". The outer shell of this structure is of high-density concrete blocks. Inside this, separated by several inches of air space, is another room, the walls of which are fabricated of panels of a high-density cement and asbestos composition. This entire internal structure, 25 x 25 x 27 ft, is completely suspended on special vibration-absorbing felt hangers.

The chamber is lined on all sides, including floor and ceiling, with thick glass fiber batts, hung edge-wise to the wall in alternate widths of 1, 2 and 4 ft. A fabric core in the glass fiber material supports the insulating material from the ceiling. A removable open grid of steel serves as the floor. Equipment may be suspended from the ceiling, too.

#### Tunable Maggies Now Stay Tuned

Latest advance in voltage tuning of magnetrons was described recently by scientists of G. E. Research Laboratory, Schenectady, N. Y. In earlier voltage-tunable magnetrons, limitation of space charge was accomplished by the careful regulation of the temperature of the electron-emitting cathode in the tube. Now a new type of grid control and electron injection method has been devised for a "crossed-field beam control system using a space-charge limited emitting source." The result is much greater stability, since the tube operation does not fluctuate with heater power supply variations. It also means longer life because the vulnerable cathode is protected.

The new voltage-tunable magnetron is akin to the new metal and ceramic micro-miniature tubes. It is a stack of four copper bands separated by ceramic disks, the entire tube being less than one-half inch high.

The anode voltage-tuning is virtually instantaneous, it is linear, and it can be performed over a very wide band. Thus the tube can serve as either a tunable cw or an fm source. In addition, a control electrode permits am modulation and makes pulse modulation feasible. In the novel cathode design, the emitter is placed outside the rf section of the tube. This reduces the detrimental effects of back bombardment present in conven-

tional magnetrons and promotes longer life and greater reliability. Countermeasures, altimeters, fm communications, and test equipment are among the many applications for this important new type of tube.

Research on the voltage-tunable magnetron has been conducted by General Electric under sponsorship of the U. S. Army Signal Corps.

A magnetron that is tunable from 8750 to 9600 mc with a peak power output of 200 kilowatts and intended for service as a pulsed oscillator in radar systems has been developed by the RCA Tube Division. The new tube (RCA- 6865) offers the advantages of providing in one tube an adjustable frequency for radar equipment without requiring appreciably more space than that occupied by a fixed-frequency magnetron having comparable power output. The 6865 is available only to U. S. military service. It is understood to be mechanically tuned and to have good frequency stability and uniform output. The tube operates with high efficiency at pulse durations up to 2.5 microseconds.



## El-Menco DUR-MICA Capacitors will match your equipment's life expectancy to at least 15 years!

### Oil Pressure Measuring System

An oil pressure measuring system eliminates bulky and dangerous oil lines in jet aircraft. The system, developed jointly by Thomas A. Edison, Inc., W. Orange, N. J., and Wright Air Development Center, is lighter, more durable, and more accurate than conventional systems.

The new measuring system has only two components, a pressure transmitter mounted on the engine and an indicator in the aircraft's flight compartment. In the transmitter, a metal bar attached to the diaphragm rides in and out of an electrical field as the diaphragm responds to changes in oil pressure. Variations in the electrical field are then translated into readings in the indicator. The transmitter gives accurate oil pressure readings in temperatures ranging from -65 F to 450 F.

### SOS SUB SUNK SOS

That's the distress signal rescue stations can receive within minutes after a submarine hits bottom. The transmitter is a radio buoy ejected from the sunken sub.

The unit, developed for the U. S. Navy by the Servo Corp. of America, New Hyde Park, N. Y., is also a beacon that locates the exact position of the distressed craft. It can transmit the message SOS SUB SUNK SOS over a radius of 60 miles at 121.5 Mc. The buoy is three in. in diam and 39.5 in. in length. It has a folding, 20-in. antenna.

The buoy operates on a 5-cell, 7.5-v magnesium silver chloride battery activated by sea water serving as the electrolyte. The instrument can also be dropped by aircraft in distress over water.

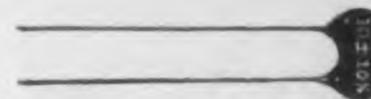
A recent series of the toughest trials has proved El-Menco DM15, DM20 and DM30 Dur-Mica Capacitors outlast all others. Accelerated conditions of 1 1/2 times rated voltage at ambient temperature of 125° centigrade found El-Menco capacitors still going strong after 10,000 hours. Similar conditions obtaining under normal usage would equal a lifetime of over 15 years!

Tougher phenolic casing means longer life, greater stability, over wide temperature range.

Meet all humidity, temperature, and electrical requirements of both civilian and MIL-C-5 specs.

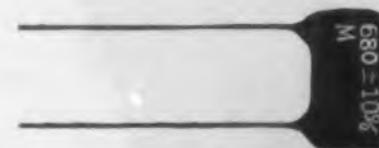
Parallel leads simplify use in television, electronic brains, miniature printed circuits, computers, guided missiles, and other civilian and military applications.

DM15



Actual Size

DM20



Tell us your specific needs. Write for FREE samples and catalog on your firm's letterhead.



El-Menco Dur-Mica DM15, DM20, and DM30 Capacitors Assure:

1. LONGER LIFE
2. POTENT POWER
3. SMALLER SIZE
4. EXCELLENT STABILITY-SILVERED MICA
5. PEAK PERFORMANCE



Take Your Own Word For It. Test El-Menco Dur-Mica Capacitors Yourself.

## THE ELECTRO-MOTIVE MFG. CO., INC.

WILLIMANTIC, CONNECTICUT

• molded mica • mica trimmer  
• tubular paper • ceramic

ARCO ELECTRONICS, INC., 64 WHITE ST., NEW YORK, N. Y.

Exclusive Suppliers to Jobbers and Distributors in United States and Canada.

CIRCLE 7 ON READER-SERVICE CARD FOR MORE INFORMATION



## Time Means Nothing to a Daven Attenuator

Time and time again we hear that 10, 15, 20 . . . yes, even 25 years continuous use can be expected from **Daven** attenuators under normal conditions. A number of our customers expect 22-year life. This expectation is based on their experience with **Daven** attenuators still in operation which were purchased 25 years ago.

This kind of durability in electronic equipment isn't an accidental by-product at **Daven**. Skilled engineering at every step of design and production assures that **Daven** attenuators consistently outperform original equipment specifications. Check these exclusive **Daven** features that add up to leadership in the attenuator field:

### "Knee-Action" Rotor

- Tamper proof
- Uniform contact pressure and low contact resistance over the life of every unit.
- Each rotor blade individually supported to give positive contact in operation under all types of conditions.

### Low-Loss Molded Terminal Board

- For high resistance to leakage.

### Rigidly Self-Supported Resistor Strips

- With air insulation.

### Brass Case of 2-Piece Construction

- Greatly reduces clearance space required for removal of cover in rear of unit.

### "Lock-Tite" Dust Cover

- Held by positive, bayonet-type lock which prevents cover from becoming detached under stress of vibration.

### Enclosed Roller-Type Detent Mechanism

- For extra long life and positive indexing.
- Addition of detent does not increase depth of unit.

Write for catalog.



THE **DAVEN** CO.

524 West Mt. Pleasant Ave., Livingston, N. J.

*World's Largest Manufacturer of Attenuators*



### Transistor P.A. Mobile Unit

This 4 w mobile transistor public address amplifier, designed to operate from a 12 v battery, has been produced by David Bogen Co., Inc., New York 14, N.Y.

Model BT12 is compact, light weight and mounts easily under a dashboard. On the front panel are the connections or controls for microphone, speaker, fuse, volume control and power on-off switch.

### Ceramics Made Heat and Chemical Resistant

"Flame Ceramics," a novel method of coating metals and other substances with ceramic materials has been developed at Armour Research Foundation of Illinois Institute of Technology.

This flame spray technique makes it possible to cover rockets and missiles with a protective coating able to withstand high temperatures. During tests, it was noted that the underlying metal actually melted without causing coating failure.

The sprayed composition is a powder usually composed of an alumina or zirconia oxide with other necessary additives to give the desired coating. The powder, contained in a hopper, is blown through a flame torch. Surfaces to be coated are sand or grit blasted. Non-metals need not be sandblasted but should be cleaned thoroughly. Material to be coated does not require high preheating.

Continental Coatings Corp., Chicago, has been granted world-wide rights to this process.

◀ CIRCLE 8 ON READER-SERVICE CARD

### Stevens Institute Offers Computers Courses

Leading to the degree of Master of Science, a graduate program in the design, selection and operation of computers will be inaugurated this fall at the Stevens Institute of Technology, Hoboken, N. J. To be made available to full-time industry employees, classes will be held two nights a week for three years, beginning September 24, 1956.

Graduates of the new program will be able to design and build computers for special requirements as well as make selections from among standard models. Graduates will also be able to prepare the information to be fed to the machines.

In the first year of the three-year program emphasis is given to mathematics and to the study of electrical circuits, while in the second year the program is concentrated on thorough study of the two general classes of computers: analog and digital. In another second year course the methods of planning and control in the industry are also considered.

In the final year the program covers linear programming, a key to automated production, and the programming or preparation of information for computing devices. During the last year students will also learn to use the specialized mathematical techniques grouped under the theory of games, and will review case studies of current computer practices.

Applications for admission to the computer program are being accepted from college graduates with a degree in engineering, mathematics or the physical sciences.

### Littelfuse Installs IBM Equipment

The installation of a full complement of IBM equipment to handle automatically the hundreds of orders for fuses received daily from electronic, automotive, and military fields has been completed at the Des Plaines, Ill. offices of Littelfuse Inc.

Customers are assured efficient and rapid service on orders. All paper work is handled by an automatic procedure which accelerates and expedites the movement of customers' orders through the plant.

CIRCLE 9 ON READER-SERVICE CARD ➤

**DU PONT**  
REG. U. S. PAT. OFF.

**ELECTRONIC DESIGN**  
PROPERTY AND APPLICATION DATA ON THESE  
VERSATILE ENGINEERING MATERIALS: "ZYTEL,"  
"ALATHON," "TEFLON," "LUCITE."

# NEWS

### Fastenings of ZYTEL® won't shake loose



Fastenings made of "Zytel" nylon resin are available in many types and sizes. An example is the "Nylo-Fast" fastenings shown above. These precision-machined bolts are lightweight and durable. The resiliency of "Zytel" permits interference fit which prevents loosening under vibrational conditions. The electrical insulating properties of "Zytel" are good. Temperatures as high as 250°F. will not affect the "Nylo-Fast" parts of "Zytel." Where color coding is desirable, various colors are available. (Manufactured and stocked by Anti-Corrosive Metal Products Company, Inc., Castleton-on-Hudson, New York, from rod stock supplied by The Polymer Corporation of Reading, Pa.)

### Laminations of TEFLON® for printed circuit bases

Typical uses for laminations of glass cloth and Du Pont "Teflon" tetrafluoroethylene resin include: conductor and ground insulation, hookup wire, power cable, printed circuit bases and structural parts. The laminations combine the dielectric properties, chemical inertness and heat resistance of "Teflon" with the tensile strength, resistance to cut-through, and resistance to creep, of woven glass fiber.

An informative free bulletin describing the preparation and uses of laminations and impregnations of glass cloth employing "Teflon" tetrafluoroethylene resin is now available. Specify Bulletin X-64.



Coil forms of "Zytel" for the General Electric AK-4 and AK-5 hook-on volt-ammeters are shown above. The high dielectric strength and easy moldability of this material make it suited for such applications. Photo below shows relative size of easily held volt-ammeter.

### Light, molded coil forms of ZYTEL® simplify ammeter design problem

Compact designs, such as the coil form for this G.E. hook-on volt-ammeter, are possible when using "Zytel" nylon resin. This is because "Zytel" can be molded into complex shapes . . . retains its strength even in thin sections. Another important advantage of Du Pont "Zytel" is that it can be injection-molded at low cost per part.

In electronic applications of all kinds, "Zytel" offers many design advantages. Whether it is used for molded components or jacketing for wire and cable, its mechanical strength and heat resistance, coupled with its superior in-



insulating characteristics, give outstanding results. A thin jacketing of "Zytel" nylon resin on electrical wire provides good insulation and abrasion resistance.

You can get all the details on "Zytel" by mailing the coupon below.

### NEED MORE INFORMATION?

CLIP THE COUPON for additional data on the properties and applications of these Du Pont engineering materials.

\*"Teflon," "Alathon," "Zytel" and "Lucite" are registered trade-marks of E. I. du Pont de Nemours & Co. (Inc.).

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department  
Room 419, Du Pont Building, Wilmington 98, Delaware  
In Canada: Du Pont Company of Canada Limited,  
P. O. Box 660, Montreal, Quebec.

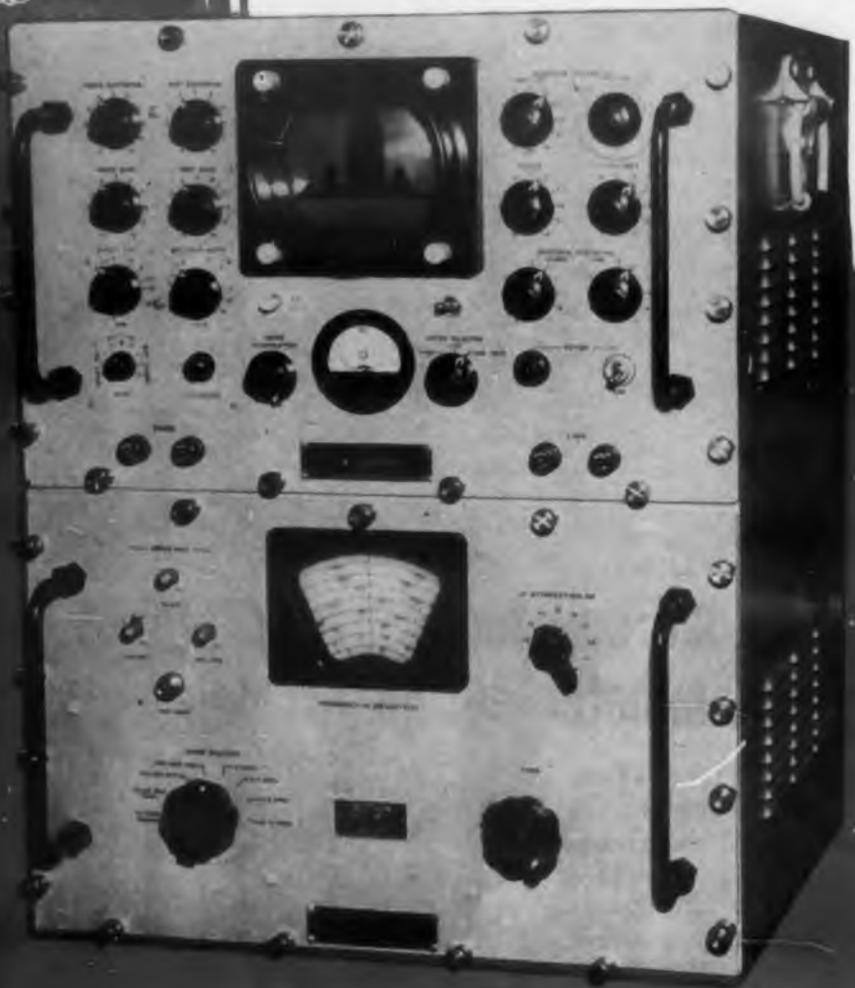
Please send me more information on the Du Pont engineering materials checked:  "Teflon"\* tetrafluoroethylene resin;  "Alathon"\* polyethylene resin;  "Zytel"\* nylon resin;  "Lucite"\* acrylic resin. I am interested in evaluating these materials for \_\_\_\_\_

NAME \_\_\_\_\_  
COMPANY \_\_\_\_\_ POSITION \_\_\_\_\_  
STREET \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_  
TYPE OF BUSINESS \_\_\_\_\_

# Introducing

# Lavoie

## A NEW AND GREATLY ADVANCED SPECTRUM ANALYZER the LA-18



*Extremely Versatile...  
Unusually Adaptable*

Used with the Lavoie LA-61 Frequency Meter, the LA-18 can easily measure from 500MC to 35,000MC with .001% accuracy.

Used with the Lavoie LA-61 Frequency Meter and the LA-800 WWV Comparator, the LA-18 becomes the Model LA-670 Microwave Frequency Standard.

Send for brochure on the LA-18 and the name of our nearest engineer representative who will arrange a practical demonstration AT YOUR PLANT—to suit your convenience.

### With these OUTSTANDING FEATURES

- Rock-stable oscillators permit observation even of signals with minor instability characteristics.
- Simplified band-switch arrangement permits coverage of entire 10MC to 32,000MC range in seconds.
- Wide-range sweep provides adequate display of even long-range radar spectra.
- Vernier marker pip provided for  $\Delta f$  measurements.
- "One-head" design absolutely precludes misplacing tuning units. NO SEPARATE HEADERS TO BUY.
- TRIPLE SHIELDING allows operation in powerful fields without spurious responses.
- Sensitivity better than  $10^{-12}$  W/Hz throughout most of the range.
- Ruggedly constructed for dependable ruggedness without excessive weight. Removable subassemblies simplify servicing.

#### ADVANCED ELECTRONICS

- Research
- Development
- Manufacture

## Lavoie Laboratories, Inc.

MORGANVILLE 7, NEW JERSEY

#### Atomic Power Engine Runs 66 Days

The US Atomic Energy Commission recently announced that the land-based prototype of the submarine Nautilus at the National Reactor Test Station in Idaho was routinely shut down, completing what is believed to be the longest (1600 hours), continuous, full power run ever completed by any type of propulsion plant.

The test proved the reliability and stamina of pressurized water reactors for ship propulsion. US Navy officers and men, who formed part of the personnel complement during the tests, will man future atomic power ships of the fleet.

#### Solving the Scientific Manpower Shortage

James O. Bengston, president of Chicago Apparatus Co., a supplier of scientific instruments, indicated recently that laboratories are generally far ahead of other sections of the industrial plant in making efficient use of manpower.

With the view toward freeing professional workers from non-technical details, the laboratory's ratio of supporting personnel to scientists has increased from 0.75 to 1.09 during the past 5 years. This ratio can be interpreted as increasing scientific manpower by 45 per cent.

#### NY Coliseum—Well Wired for Sound

The New York Coliseum, the nation's largest exhibition building for trade shows and fairs, is using a four-in-one RCA industrial sound system to provide exhibitors with service in all sections of the \$35,000,000 structure.

The installation, planned and installed by Commercial Radio Sound Corp., New York, incorporates 4 separate sound systems, one for each exhibition floor.

Each floor has its own self-contained control system. The floors are divided into 4 separate sound zones, and programs originating from any zone on any floor can be confined to that zone, distributed to all zones on the same floor, or transmitted to any or all zones on other floors of the Coliseum.

◀ CIRCLE 10 ON READER-SERVICE CARD

# SPACE MAN...

with a  
Brief Case



#### Imported TV Camera

"Peepsqueek," the cigar-shaped TV camera, manufactured in West Germany by Grundig Radio-Werke GmbH and marketed in the U. S. by Majestic International Corp., Chicago 10, Illinois, is less than 6 in. long and has a 1-7/8 in. diameter.

Equipped with two sets of spring-loaded guide rollers, the camera can pass through pipes, or other access orifices whose ID match the camera diameter.

This remote-controlled unit contains a mini-resistor and a number of subminiature tubes that serve as amplifying elements. A conical mirror accessory may be mounted 3/4 in. ahead of the lens combination to reflect the image of inside walls. The image received can be magnified up to 20 times since the focal length of the lens system is only 1/2 in.

#### Nuclear Training for College Faculty

Responding to demands for nuclear training far beyond the capacity of the original summer school for engineering college faculty members at Argonne National Lab., a second school has been scheduled. The supplementary institute will be conducted at Brookhaven National Lab., Upton, L. I., N. Y.

Sponsored jointly by the Atomic Energy Commission, the National Science Foundation, and the American Society for Engineering Education, the Brookhaven program will accommodate 30 additional candidates. They have been selected from 22 institutions in 15 states.

Basic aim of both schools is to expand the number and scope of engineering course offerings in atomic and nuclear fields. ASEE gives overall supervision and makes final candidate selections.

CIRCLE 11 ON READER-SERVICE CARD ▶



Science has a new kind of space man these days. He carries a brief case.

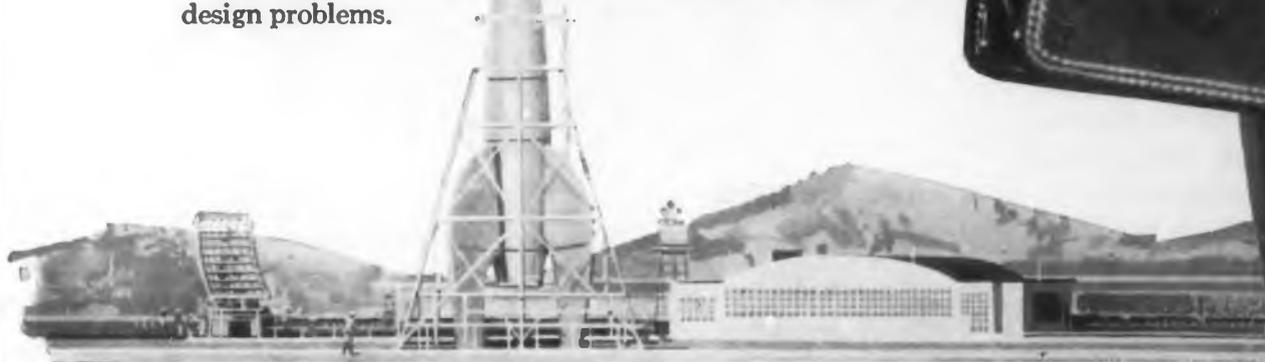
His mission is as new, as exciting and as challenging as a trip to the moon. In many cases you'll find him on the team at Remington Rand Univac®, one of the engineers or technicians who have given UNIVAC the title,

#### "First In Electronic Computing Systems"

Futures at UNIVAC are as unlimited as the space above. In fact, new facilities and fresh working conditions are being born each day at Remington Rand Univac which means that new members are needed for the Univac team. This is your chance to establish the career every man wants. Write today.

#### IMMEDIATE OPENINGS FOR:

At South Norwalk we have immediate openings for Mechanical and Electro-Mechanical Engineers with a bachelor's degree in *Engineering*. Extensive mechanical design background may substitute for some college. Men selected will do basic preliminary design and layout of small mechanisms. Work will require the development of original ideas and the ability to apply logical analysis to design problems.



Send Complete Resume to —

**Remington Rand Univac**

DIVISION OF SPERRY RAND CORPORATION

Attention Mr. A. L. Crable

Wilson Avenue • South Norwalk, Connecticut

### New Air Force Navigational Trainer

Thirteen navigator-students can be trained simultaneously in a series of identical booths, each containing all the necessary equipment which the navigator would normally have during an actual flight.

Developed and manufactured as the N-3 Navigational Flight Simulator for the USAF by Reflectone Corp., Stamford, Conn., each booth is individually controlled by an instructor-operator from a central console where an infinite variety of simulated flying conditions can be established. Meters display, "live" radio communications, and UP-2 Charts lend realism.

Mounted on the back of each booth is a large, ground-glass panel having a UP-2 Chart which can be marked by the instructor. Controlled by an analog computer, a stylus traces each student's flight pattern. Comparison of this chart with the student's own plot can be made at the end of the "flight".

### Proportioning Panel Records Formulas on Punch Card

An electronically controlled proportioning system automatically records formulas and weighings on a summary punch card by means of a recording device interlocked with the action of the panel. The system combines the automatic proportioning features of a control system with a printing summary punch. Information is transmitted by means of digitizing equipment, which digitizes individual weighing and sends the information to a summary punch.

The equipment, made by Richardson Scale Co., Clifton, N. J., is designed for full-automatic or semi-automatic operation. The equipment may be used to process billings, maintain inventory control and keep records of weighing and proportioning.

### Oxidation-Hardenable Silver Alloy

A silver-magnesium-nickel alloy (99, 0.27, 0.20 per cent respectively), developed by Handy and Harman, 82 Fulton St., New York 38, N. Y., has the property that it is easily worked while soft and then can be irreversibly hardened by heating in air.

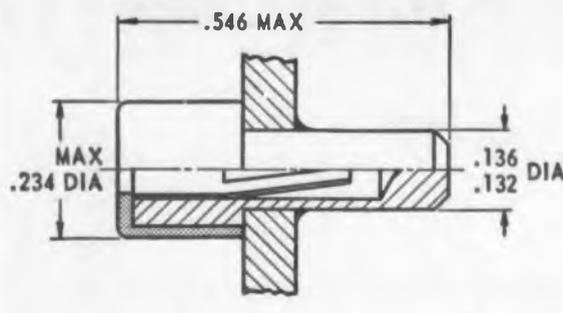
Once hardened, this silver alloy has a low creep rate and for all practical purposes does not anneal at elevated temperatures. Annealing, however, can be done in air at 700 F or in a non-oxidizing atmosphere above 700 F.

Suggested applications for this alloy: electrical contacts which can be attached by brazing without loss of hardness; shields and clips for vacuum tubes requiring high thermal conductivity; instrument and relay springs; contact arms; wipers and sliders requiring high conductivity and hardness at elevated temperatures.

# NEW SOLUTIONS

From RAYTHEON—a quality

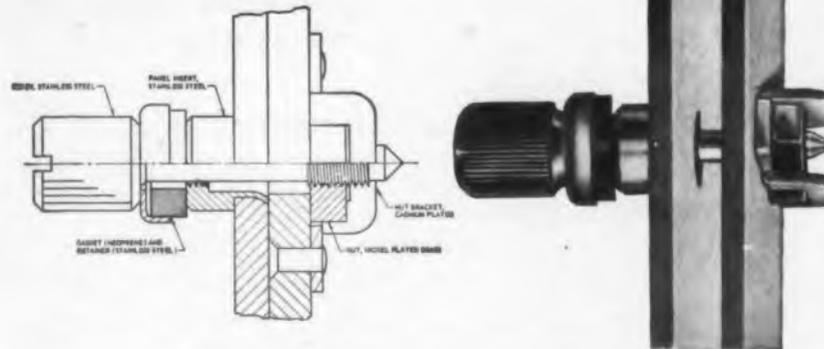
## TEST JACKS FOR PRINTED CIRCUITS



**PROBLEM**—Convenient test points are needed on printed circuit panels. Jacks must lend themselves to easy assembly and automatic dip soldering.

**SOLUTION**—Raytheon's new printed circuit test jacks. No mounting hardware—for panels 1/32 to 1/4" thick. Can be dip soldered. Unique beryllium copper spring-pin contact. Accommodates standard .080 diameter test prod. 8 colors. (Also available—Raytheon subminiature and standard test jacks.)

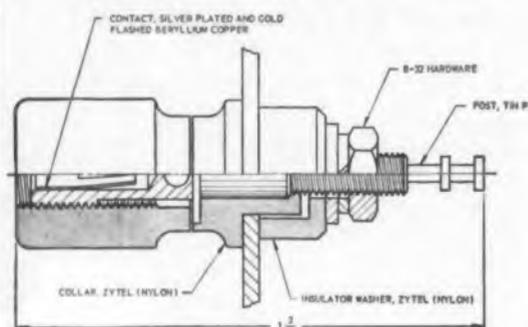
## CAPTIVE HARDWARE



**PROBLEM**—To meet military specifications for captive hardware.

**SOLUTION**—Raytheon supplies the complete assembly at the lowest cost available. Consists of a stainless steel captive screw (variety of lengths) and panel insert; nickel plated brass floating nut; cadmium plated nut bracket; Neoprene gasket and stainless steel gasket retainer. Thread sizes: 10-24, 1/4-20, 5/16-18.

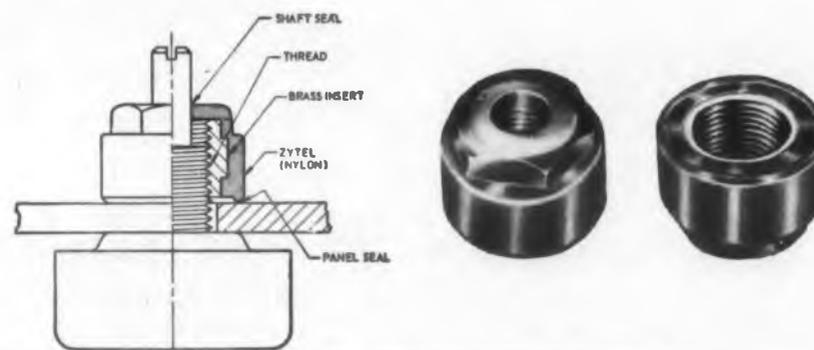
## 5-WAY BINDING POSTS



**PROBLEM**—A compact, high-strength binding post incorporating a test jack is required.

**SOLUTION**—Raytheon binding posts are made of nylon and brass and include a beryllium-copper spring pin contact for plug in of .080" diameter prods. Other connections: prod or wire clamped thru center hole; wire coiled around post and clamped. Turret Terminal for solder connection. Available in black or red.

## SHAFT LOCKS



**PROBLEM**—To retain adjustment of slotted shaft potentiometers under conditions of vibration and shock.

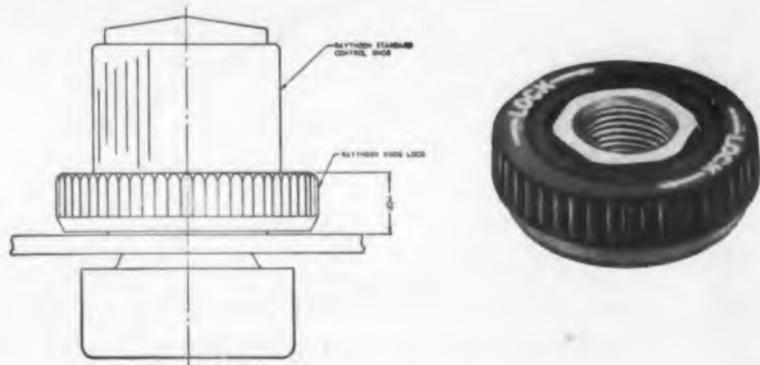
**SOLUTION**—Raytheon shaft locks provide constant drag on potentiometer shafts. Permit smooth adjustment without unlocking, but prevent vibration or shock from moving shaft. Also provide water and dust proof seal of shaft and panel. Made of nylon and brass. Replaces potentiometer mounting nut. For 1/4" and 1/8" shafts.

CIRCLE 12 ON READER-SERVICE CARD FOR MORE INFORMATION

# TO OLD PROBLEMS

line of panel components

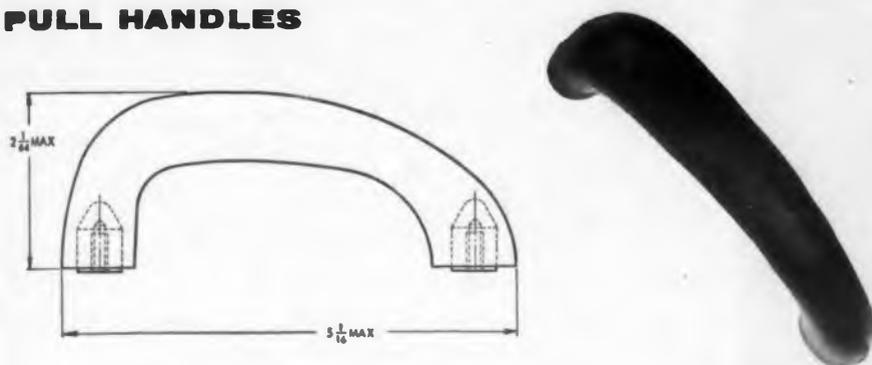
## KNOB LOCKS



**PROBLEM**—To retain control settings under conditions of vibration, shock or accidental manual contact, yet permit easy adjustment.

**SOLUTION**—Raytheon knob locks are rotated one eighth turn clockwise to hold setting securely under all conditions. Reversing lock permits easy re-setting of control. Simple rugged construction. Design matches Raytheon Standard Control Knobs.

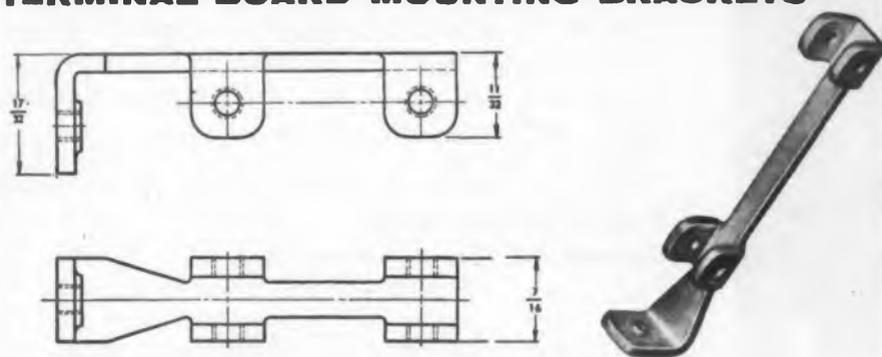
## PULL HANDLES



**PROBLEM**—Functional design, high strength and attractive appearance are needed for pull handles.

**SOLUTION**—Integrated in design and appearance with Raytheon Standard Control Knobs, Raytheon pull handles have a unique "contour grip" shape. Molded of "Tenite II" with anodized aluminum inserts for maximum strength and impact resistance. Mirror or matte finish available.

## TERMINAL BOARD MOUNTING BRACKETS



**PROBLEM**—Brackets which meet military specifications for vibration and shock are required for mounting terminal boards or printed circuit panels.

**SOLUTION**—Made of cadmium plated steel, Raytheon mounting brackets meet mil specs for withstanding rugged conditions. Brackets may be used for mounting one or two boards. Available in four sizes—2-1/16 to 3-9/16" overall length for panels ranging from 1-3/8 to 3-7/16" wide.



Available from Raytheon—A complete line of Standard Control Knobs designed to meet rigid mil specs.

Now available for the first time, all the components shown here—designed to meet your specific needs. These components, in conjunction with Raytheon's Standard Control Knobs series, form a complete, integrated line from one source—to satisfy virtually all your requirements.

For full information and prices, please write Dept. 6120A.

Excellence in Electronics



A-4006

**RAYTHEON MANUFACTURING COMPANY**

Equipment Marketing Department, Waltham 54, Mass.

See Raytheon Exhibit at Room 5515A, USITA Show; Conrad Hilton Hotel, Chicago, Ill., Oct. 15-17

CIRCLE 13 ON READER-SERVICE CARD FOR MORE INFORMATION

## Washington Report

Albert Warren

### Washington Trends & Briefs

"Very favorable" is how Secy of Commerce Sinclair Weeks characterizes outlook for electronics in second half of 1956. He expects factory volume for full 1956 to reach \$6.8 billion, up 8% from last year.

. . . Radiation limits for community antenna TV systems have been formally established by FCC as follows: under Ch. 2, 15  $\mu\text{v}/\text{m}$  at 100 ft.; Ch. 2-6, 20  $\mu\text{v}/\text{m}$  at 10 ft (400  $\mu\text{v}/\text{m}$  in sparsely populated areas); Ch. 7-13, 50  $\mu\text{v}/\text{m}$  at 10 ft (1000  $\mu\text{v}/\text{m}$  in sparsely populated areas); above Ch. 13, 15  $\mu\text{v}/\text{m}$  at 100 ft. New systems built after Oct. 1 must comply with specifications from start. Existing systems must comply by Dec. 31, 1959. . . . Police TV microwave system, first of its kind, has been authorized by FCC to State of Ohio Dept. of Highway Safety. System will operate between Bureau of Automobile Licensing & Records Bldg. and State Highway Patrol headquarters, both in Columbus, giving quick visual access to auto registration data.

**Patents** . . . Atomic Energy Commission, continuing policy of releasing non-secret patents for licensing to industry, recently released 18 in electronics covering following devices: amplifier circuit, current measuring device, alpha survey meter circuit, neutronic reactor measuring and safety rod operating apparatus, fluid cooled neutronic reactor, portable scintillation survey meter, demountable filament assembly, submerged reactor, reactor, electrolytic cells, electronic analyzer, magnetic field measuring device, binary counter, ion producing mechanism, beam current regulator, arc regulator for calutron ion source, calutron receivers, power of voltage measuring means. **Information** on these and other AEC patents may be obtained from Chief, Patent Branch, Office of General Counsel, AEC Washington 25, D.C. . . . **New patent index** is service offered by Information for Industry Inc., 1108 16th St. NW, Washington. Published annually, the "Uniterm" index breaks patents down into key words for easy search by designers, patent attorneys, etc. First volumes cover the 3130 electronic patents issued in 1955, but consideration is being given to indexing those issued during 1950-54. Analysis of 1955 patents shows that about 10% were assigned to U.S. Govt. **Next largest assignees:** RCA, 262; Bell Labs, 170; GE, 118; Westinghouse, 85; IT&T, 51; Bendix Aviation, 50; Raytheon, 44; Stromberg-Carlson, 32; IBM, 30; DuMont, 29; Sperry Rand, 26; Collins, 24; Philco, 23; Motorola, Sylvania & Hughes Aircraft, 22 each; Phillips Petroleum, 19.

# NEW 8 CHANNEL

**Sanborn**

**oscillographic**

**recording**

**system**

**PRIMARYLY  
FOR USE WITH  
ANALOG COMPUTERS**

**COMPLETE  
COMPACT  
SELF-CONTAINED**

**T**his new self-contained 8-channel oscillographic recording system, primarily for (but not limited to) analog computer recording, measures only  $46\frac{1}{2}'' \times 27'' \times 22''$ . In a single, space-saving mobile package, the user has a complete system for analog computer readout recording. Input cable connections are easily made at the top of the back panel. Eight groups of controls for the eight channels are conveniently located on the sloping top panel. Driver Amplifier chassis are easily withdrawn from the lower part of the console for inspection. Paper loading is quickly done from the top.

Features of the Model 158-5490 system include 0.1v/cm to 100v/cm sensitivity; over-all linearity of 0.25 mm over the entire 4 cm of the chart; drift less than 0.5 mm/hour; push-pull or single-ended input; miniaturized dual-channel DC amplifiers of improved current feedback design; 5 meg. input impedance each input lead to ground; true rectangular coordinate recording; nine chart speeds from 0.25 to 100 mm/sec. Frequency response is flat to 20 cps, down 2 db at 60 cps for all amplitudes to 4 cm peak to peak.

**FAMOUS "150" SYSTEMS . . . for all recording requirements**



In laboratories, production testing facilities and field installations nationwide Sanborn 150 Series Oscillographic Recording Systems are proving their versatility and value. Users have a choice of basic systems ranging from 1 to 8 channels . . . "packaged" as portable units or in vertical mobile cabinets . . . and twelve interchangeable plug-in preamplifiers permitting rapid, economical changeover to new input requirements.

On display at Booth #811 Instrument-Automation Conference and exhibit at New York Coliseum, September 17-21.

CIRCLE 13 ON READER-SERVICE CARD FOR MORE INFORMATION

Sanborn will gladly furnish complete descriptive data on the new 158-5490 System and all "regular 150" systems, or engineering assistance on your recording problems, whenever you wish. Contact your Sanborn Representative, or write to . . .

**SANBORN COMPANY**

INDUSTRIAL DIVISION

195 MASSACHUSETTS AVE., CAMBRIDGE 30, MASS.

## Letters to the Editor

**Dear Sir:**

We were very pleased with the appearance of our article in the July 15th issue of **ELECTRONIC DESIGN**. Permit us to congratulate you on what we consider to be an excellent job of editing and layout. However, we detected a few minor errors (in the article "Design Considerations for Semiconductor Power Supplies") which we should like to call to your attention.

On page 23 in the Editor's Note . . . equations . . . should only refer to the circuit of Fig. 1; . . . the implication is that they refer to all the circuits.

. . . In line 6 of the right hand column, page 23, the phrase should read "for  $R_c/R_b \gg 1$ , usually  $R_L/R_b$  and  $R_L/R_c < 1$ ." (The "1" following the "less than" symbol is missing in the article.)

. . . In line 5 on page 25, the . . . statement is (made) "a second transistor is paralleled across the original one." . . . (more accurately) "a second transistor is cascaded in the complementary connection to the original one." . . . (In the heat sink discussion  $\Delta t$  was not defined.)  $\Delta t$  may be defined as the drop between the dissipator and the ambient and is equal to  $PR_{t_a}$  in Fig. 7.

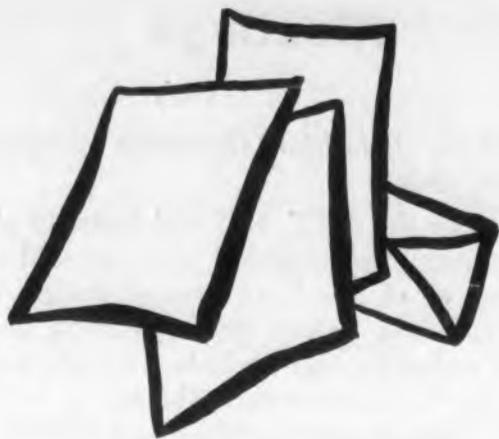
**S. Sherr, Section Head  
General Precision Laboratory Inc.**

We thank Mr. Sheer for calling these corrections to our attention. We hope the above will clarify any misconceptions that may have been conveyed to our readers. **Ed.**

**Dear Sir:**

We have just had the pleasure of reading a copy of your July 15, 1956 issue of **ELECTRONIC DESIGN**. However, we are sorry to note in the article entitled "Patents," by John Montstream, that on page 90 in the section describing Patent No. 2,736,000, our trade-mark, "Fathometer," has been misused as though it were a generic term for depth sounders.

We must point out that "Fathometer" is a registered trade-mark belonging exclusively to Raytheon



and can be correctly used only in connection with our Company and the Submarine Signal Co., our predecessor in the depth sounder business, for nearly 30 years.

We realize, of course, that the misuse may have been due to similar misuse in the referred to patent. This misuse in the patent has been brought to the attention of the Commissioner of Patents, who has assured us that steps are being taken to rectify the situation. However, in order to protect a valuable property right belonging exclusively to the Raytheon Manufacturing Company, it is necessary that we call this matter to your attention, and ask your cooperation. . . .

Gerald Singer, Patent Solicitor  
Raytheon Mfg. Co.

Mr. Singer's letter speaks for itself. **Ed.**

Dear Sir:

Your readers may be interested to learn that the Russian-made Thermocouple generator, described on page 83 of your May 1st issue, is exactly like four such generators which I made in 1922, and which I still have. These were heated, either by flame lamp, or by an internal resistance wire, fed by ac house current. Mine used iron-constantan junction elements, and developed 6 w at 6 v and 1 a in an external load.

Benjamin Franklin Miessner  
Morristown, N. J.

It may be of interest to our readers to learn that a new model of a thermo-couple power pack for battery operated receivers, energized by kerosene, is reported in the February, 1956, issue of the Russian publication *Radio*. It is known as the Model TECK-2-2 and differs from the earlier model in that B voltage is generated directly, without a vibrator. A substantial reduction in the noise level results, according to the claims made. **Ed.**

TYPE	RES. RANGE		POWER RATING		LENGTH
	MIN.	MAX.			
R	10 Ω	1,000 K	7-115 W	DC	1½" to 12"
H	10 Ω	1,000 K	7-140 W	AC	1½" to 12"
HP	10 Ω	500 K	17-150 W	DC	3" to 12"

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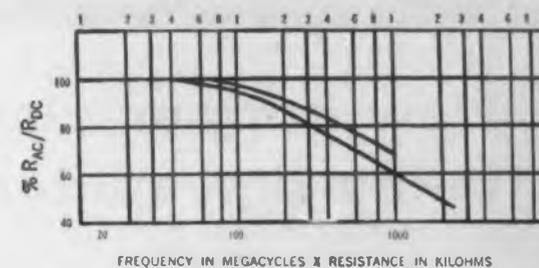
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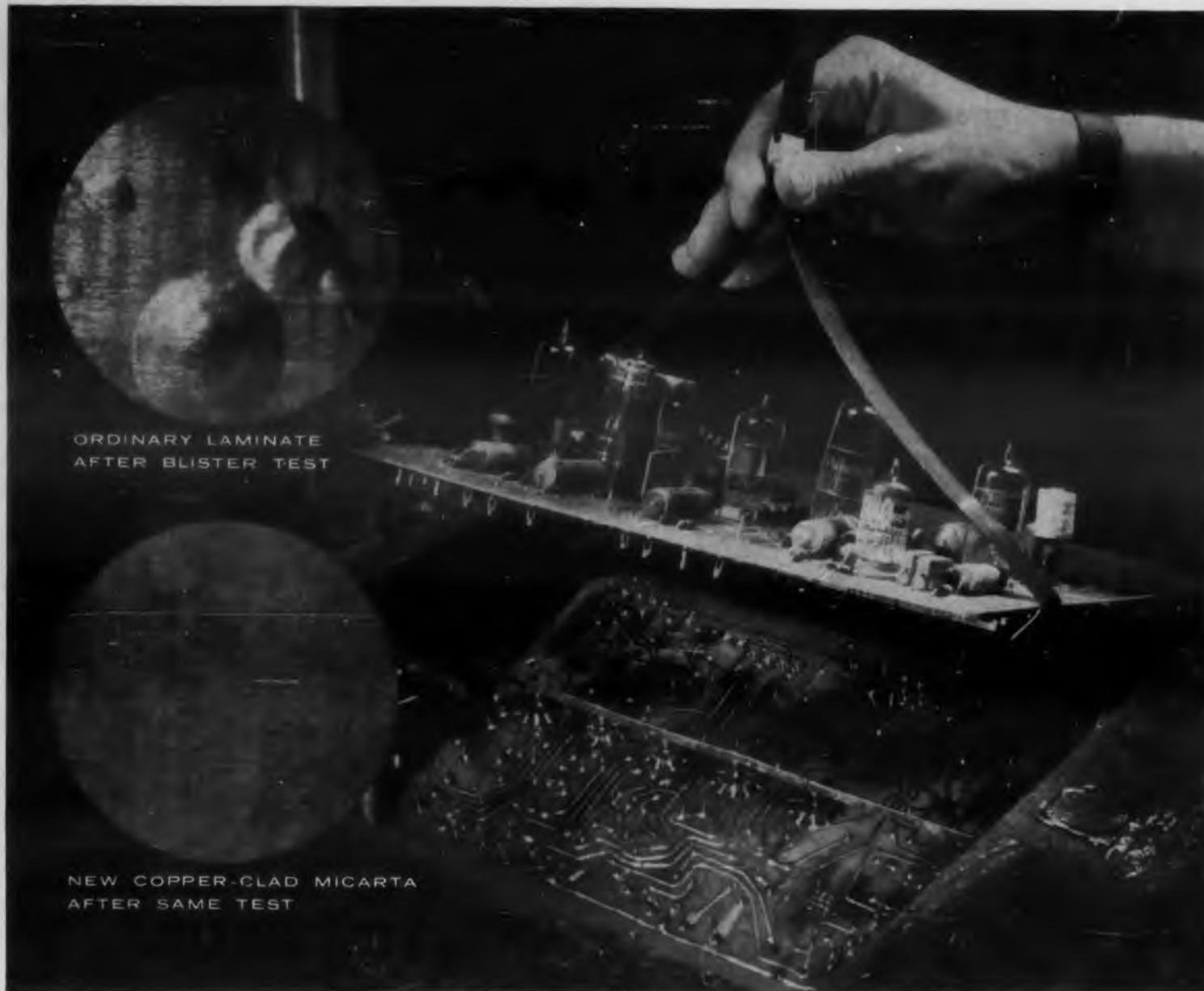


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Components Department, Electrical Products Division

*Corning means research in Glass*

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AFTER SAME TEST

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New H-3032 copper-clad MICARTA<sup>®</sup> cuts costs and production time of printed circuits. Copper-clad MICARTA speeds up soldering, without the normal accompaniment of an increase in rejects and missed connections. It can be cold punched without cracking or chipping.

The laminate won't blister even when dip soldered for 10 seconds at 500°F! Examine the two close-up photographs. One shows an ordinary laminate after a laboratory test. Note the blistering, then look at the MICARTA dip soldered for the same length of time—and there is no blistering!

A special adhesive is used which has the same

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Because of a new adhesive process, copper-clad MICARTA keeps its high bond strength—from 10 to 13 pounds versus an industry standard of six pounds—even after heating and cooling is repeated many times. This is especially valuable for electronic circuits.

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## Meetings

### **Sept. 24-25: Industrial Electronics Conference, Cleveland, Ohio.**

Sponsored by the AIEE, IRE and Institute of Radio Engineers. The technical program will cover such areas as electronic equipment design, automatic production, testing, gaging, process control, and data reduction and analysis. For information, write Carl F. Schunemann, Thompson Products Inc., 2196 Clarkewood Rd., Cleveland 3, Ohio.

### **Sept. 26-29: Audio Engineering Society Convention.**

New York Trade Show Building, New York, N. Y. Sponsored by the AES, and held concurrently with the New York High Fidelity Show. Disc recording and reproduction, magnetic recording, transistor application problems, audio systems and components, loudspeakers and standards and measurements will be the subjects of the sessions. For information, contact G. K. Dahl, 230 W. 41st St., New York 36, N. Y.

### **Oct. 1-3: Twelfth Annual National Electronics Conference.**

Hotel Sherman, Chicago, Ill. Sponsored by the AIEE, IRE, Illinois Institute of Technology, University of Illinois, and Northwestern University. More than 100 technical papers and 240 commercial exhibits will be featured. For information, write to Victor J. Danilov, Illinois Institute of Technology, Chicago 16, Ill.

### **Oct. 1-3: Canadian Institute of Radio Engineers Convention.**

Automotive Building, Exhibition Park, Toronto, Canada. Technical papers are planned on medical electronics, scatter propagation, application of electronics to atomic energy projects, use of computers in automation and engineering problems, and transistors. An exposition will include many of the latest improvements in radio, radar, TV, control mechanisms, computers, and other electronic items. For information, write to Grant Smedmor, Convention Manager, 745 Mount Pleasant Rd., Toronto 12, Canada.

### **Oct. 1-5: AIEE Fall General Meeting.**

Morrison Hotel, Chicago, Ill. Tentative schedule includes sessions on rotating machinery, protective devices, metallic rectifiers, insulated conductors, dielectrics, air transportation, land transportation, switchgear, feedback and control systems, electronics, computing devices, nucleonics, and management. For information, write to AIEE, 33 W. 39th St., New York 18, N. Y.

**Oct. 3-5: Fifth Annual Meeting of the Standards Engineers Society.**

Willard Hotel, Washington, D.C. Topics expected to be of particular interest to standards engineers in the electronic field are the session devoted to "Dynamic Standards for the Median Company" and the session devoted to "Drawing Practice Standardization." Additional information may be obtained from the Washington Section, Standards Engineers Society, 4042 N. 35th Street, Arlington 7, Va.

**Oct. 8-9: Second Annual Symposium on Aeronautical Communications.**

Hotel Utica, Utica, N. Y. Sponsored by the IRE Professional Group on Communications Systems. The symposium will stress communication requirements in support of present and future aeronautical activities. For additional information, write to R. C. Benoit, Jr., 138 Riverview Parkway N., Rome, N.Y.

**Oct. 8-12: Society of Motion Picture and Television Engineers Convention.**

Los Angeles, Calif. A technical session will be devoted to a program of papers on transistors and their applications to motion pictures and television. For additional information, write John B. Olsson, Houston-Fearless, 11801 W. Olympic Blvd., Los Angeles 64, Calif.

**Oct. 9-10: Computer Applications Symposium.**

Morrison Hotel, Chicago, Ill. Sponsored by the Armour Research Foundation of Illinois Institute of Technology. For information, contact J. J. Kowal, Conference Secretary, Armour Research Foundation of Illinois Institute of Technology, 10 W. 35th St., Chicago 16, Ill.

**Oct. 16-18: Conference on Magnetism and Magnetic Materials.**

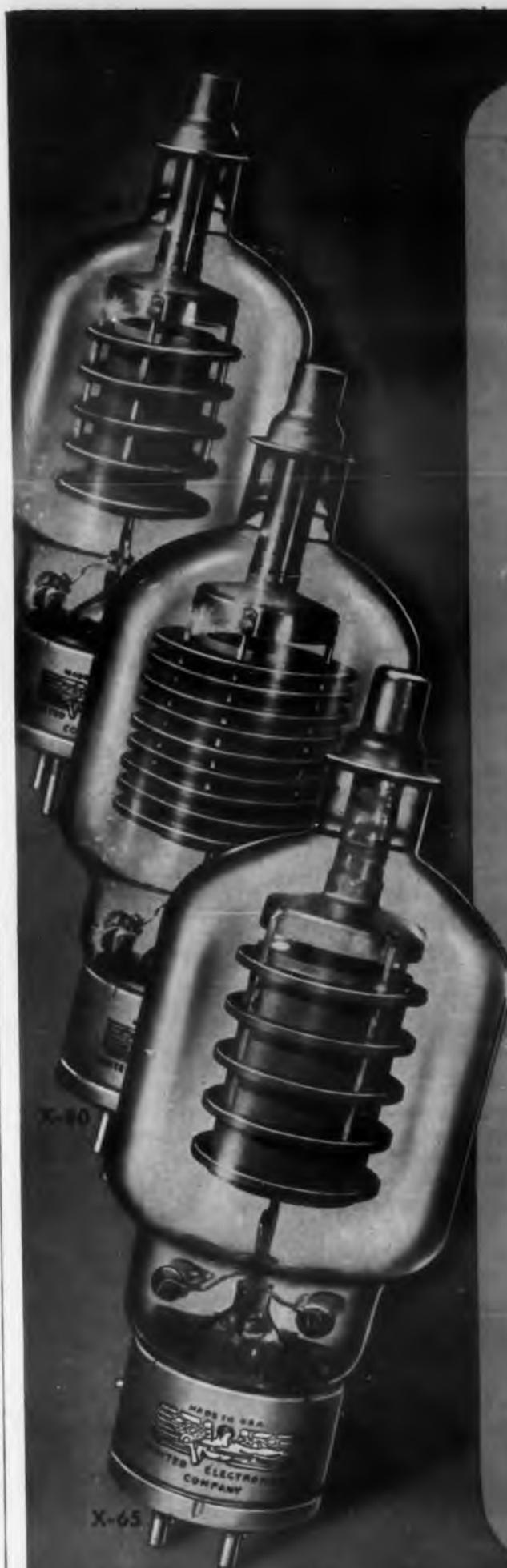
Hotel Statler, Boston, Mass. Sponsored by the AIEE, IRE, American Physical Society, American Institute of Mining and Metallurgical Engineers. For further information, write to T. O. Paine, Measurements Laboratory, General Electric Co., W. Lynn, Mass.

**Oct. 22-24: AIEE Machine Tool Conference.**

Sheraton Gibson Hotel, Cincinnati, Ohio. For information, write to AIEE, 33 W. 39th St., New York 18, N. Y.

**Oct. 25-26: Second Annual Technical Meeting of the IRE Professional Group on Electron Devices.**

Shoreham Hotel, Washington, D. C.. For information, contact Prall Culviner, Sylvania Electric Products, Inc., 1740 Broadway, New York, N.Y.



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For their size, these new tubes have greater power handling capacity than any other high vacuum convection cooled types, when used either as power supply rectifiers, clipper, hold-off or charging diodes.



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Type	Code	Filament		opt lv	Anode		Maximum Dimensions	
		Vac	Aac		lb e	lb Adc	Length Inches	Diameter Inches
561	A	11.5	15.5	30	2.7	.840	9.750	3.630
	B			30	80	.075		
X-60	A	11.5	15.5	40	2.5	.800	9.750	3.630
	B			40	80	.075		
X-65	A	5.0	11.5	65	1.0	.250	9.750	3.630

CODE: A) Rectifier B) Clipper Diode

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Several additional high vacuum diodes are being designed by UNITED ELECTRONICS which will extend the new MAJOR series with tubes of much higher power stature. If you will advise us of your rectifier-diode needs for equipment you are now designing we may be able to be of great help to you.

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APPLICATIONS

**Oct. 29-Nov. 2: Convention on Ferrites.**

London, England. Sponsored by the Institution of Electrical Engineers. Program will include sessions on theory, preparation, and properties of ferrites, microwave application, square loop applications, radio and TV applications, and carrier frequency applications. For further information, write to W. K. Brasher, Secretary, Institution of Electrical Engineers, Savoy Place, London W.C. 2, England.

**Oct. 31-Nov. 3: Gaseous Electronics Conference.**

Westinghouse Research Laboratories, Pittsburgh, Pa. Co-sponsored by the Division of Electron Physics of the American Physical Society and the Westinghouse Research Laboratories. For more information, contact A. V. Phelps, Westinghouse Research Laboratories, Beulah Rd., Pittsburgh, Pa.

**Nov. 7-9: Conference on Electronic Technology in Medicine and Biology.**

McAlpine Hotel, New York, N. Y. Sponsored by the AIEE, IRE, Instrument Society of America. For information, write to AIEE, 33 W. 39th St., New York, N. Y.

**Nov. 14-16: Symposium on Optics and Microwaves.**

George Washington University, Washington, D. C. Sponsored by the IRE Professional Group on Antennas and Propagation, the George Washington University and the Optical Society of America. For further information, contact the IRE, 1 E. 79th St., New York 21, N. Y.

**Nov. 15-16: New England Radio-Electronics Meeting.**

Hotel Bradford, Boston, Mass. Co-sponsored by the Boston and Connecticut Valley sections of the I.R.E. For additional information, contact NEREM, Room 1006, 73 Tremont St., Boston, Mass.

**Nov. 26-30: Third International Automation Exposition.**

Trade Show Building, New York, N. Y. Clinic sessions will be offered in electronic computers, process automation, machine tool automation, office automation, automatic materials handling, servomechanisms, electromechanical components, and electronic components. More than a hundred exhibitors will participate in the clinics. For information, write to Richard Rimbach Associates, 845 Ridge Ave., Pittsburgh 22, Pa.

**Dec. 5-7: Second IRE Instrumentation Conference.**

Biltmore Hotel, Atlanta, Ga. Sponsored by the Professional Group on Instrumentation and the Atlanta Section of the IRE. Sessions will be devoted to industrial applications, missile range instrumentation, and the application of solid state devices. For further information, contact the IRE, 1 E. 79th St., New York, N. Y.

**Dec. 10-12: Eastern Joint Computer Conference.** Hotel New Yorker, New York, N. Y. Sponsored by the IRE, AIEE, Association for Computing Machinery. "New Developments in Computers" is the theme of the meeting. In addition to an extensive program of technical papers, the meeting will feature exhibits by many manufacturers in the computing field. For information, contact Al Forman, Room 639, 480 Lexington Ave., New York 17, N. Y.

**Jan. 9-11, 1957: Symposium on Communication Theory and Antenna Design.**

Boston University, Boston, Mass. Sponsored by the Air Force Cambridge Research Center and Boston University. For information, contact Miss Alice Cahill, Air Force Cambridge Research Center, Air Research and Development Command, Laurence G. Hanscom Field, Bedford, Mass.

**Jan. 14-15, 1957: Third National Symposium on Reliability and Quality Control in Electronics.**

Hotel Statler, Washington, D. C. Sponsored jointly by the IRE Professional Group on Reliability and Quality Control, the American Society for Quality Control, and RETMA. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

**Jan. 23-25, 1957: Very Low Frequency Symposium.** NBS Boulder Laboratories, Boulder, Colo. Co-sponsored by the Denver-Boulder chapter of the IRE PGAP and the Boulder Laboratories, National Bureau of Standards. The program is titled "Theoretical and Experimental Results in the Propagation and Radiation of Very-Low-Frequency Electromagnetic Waves (less than about 100 kc)." Authors are being requested to submit summaries for appraisal as soon as possible to Dr. J. R. Wait, Chairman, Denver-Boulder PGAP Chapter, National Bureau of Standards, Boulder, Colo. For further information, contact U. S. Dept. of Commerce, NBS, Boulder Laboratories, Boulder, Colo.

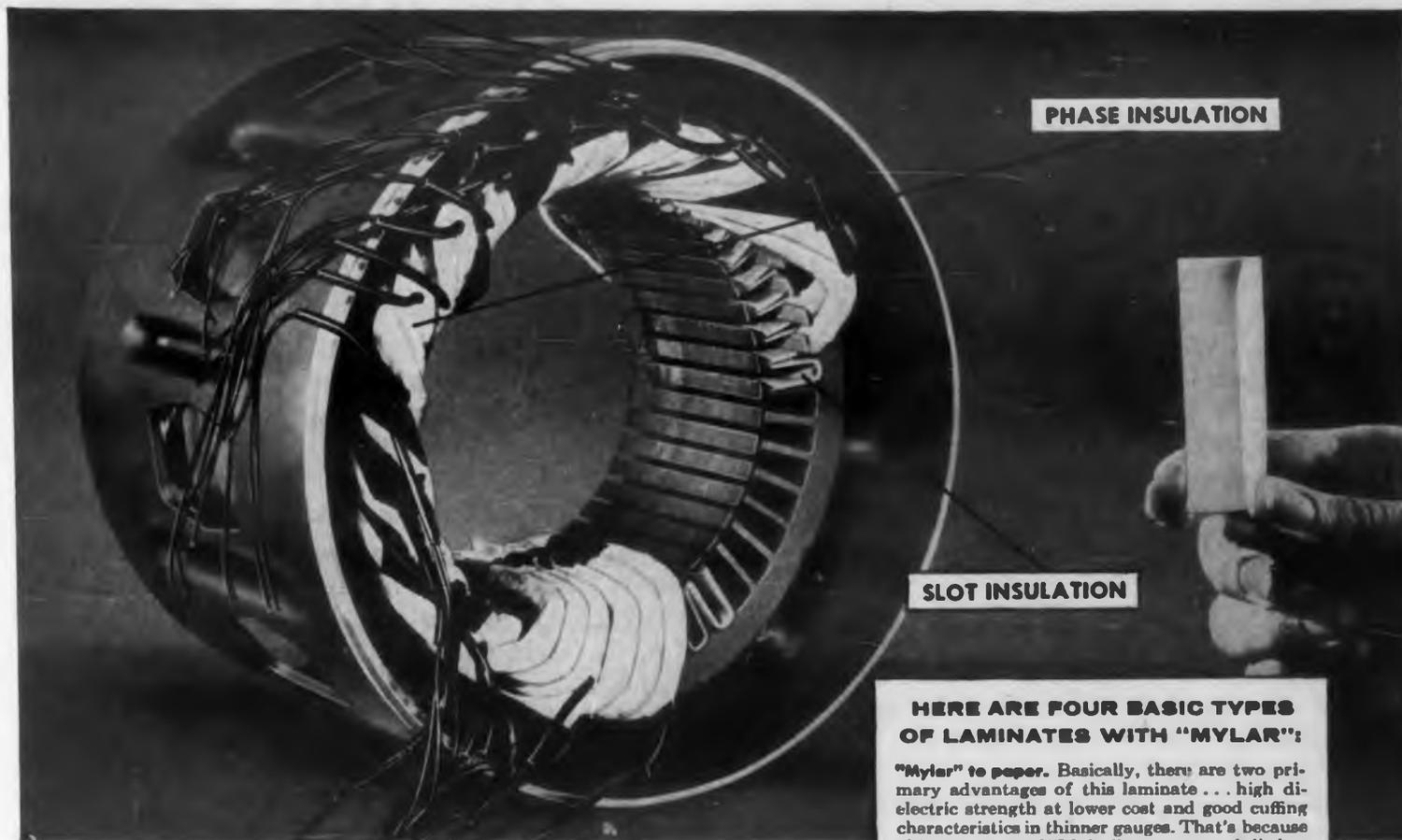
**April 8-11, 1957: Fourth National Electrical Industries Show.**

71st Regiment Armory, New York, N.Y. Sponsored by the Eastern Electrical Wholesalers Association. For more information, contact William S. Orkin, Co-Producer, The American Electrical Industries Expositions, Inc., 19 W. 44th St., New York, N.Y.

**April 11-13, 1957: Southwestern IRE Conference and Electronics Show.**

Houston, Texas. Sponsored by the Houston Section of the IRE. For information, write to Ninth Southwestern IRE Conference and Electronics Show, P. O. Box 1234, Houston 1, Texas.

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\*Du Pont manufactures the basic material "Mylar"—not finished electrical laminates. "Mylar" is Du Pont's registered trademark for its brand of polyester film.



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CIRCLE 18 ON READER-SERVICE CARD FOR MORE INFORMATION

**M**ODERN synthesis techniques have shown how to design ladder networks with the minimum possible number of elements. Three of the characteristics used in synthesis are obtained from Butterworth, Tschebyscheff, and Bessel polynomials; the first gives a maximally-flat magnitude characteristic, the second an equal-ripple magnitude characteristic, and the third a maximally-flat time delay. In this series of articles tables are presented which give the element values of normalized low-pass ladders having these characteristics; these ladders may be resistance terminated at one end or at both ends. By means of frequency transformations the low-pass characteristic may be converted to serve a high-pass, band-pass, or band-elimination function. The tables make it possible for the design of the networks to be accomplished in handbook fashion.

### Scope

The design of networks by modern synthesis techniques is now highly developed. These techniques have a great deal to offer the practical engineer who wants to build optimum networks to satisfy his requirements. However, most of the theory appears formidable to many engineers, and as a consequence networks (filters, time-delay networks, equalizers, etc.) are being used which are inefficient or uneconomical.

In the tables that follow, the three large classes of networks can be designed. By means of these tables the engineer who knows little about the theory of modern synthesis can synthesize useful networks without the necessity of carrying out laborious calculations or plowing through a mass of theory. It is fortunate that for a large class of problems the results can be given in handbook form.

Because of space restrictions only an outline of the theory for each type of function is presented; the interested reader can consult the references for additional details. However, it is believed that sufficient theory is given to acquaint the reader with the characteristics of the networks whose element values are given in the tables.

The paper is divided into a four part series. The first two will treat Butterworth and Tschebyscheff networks, respectively, while the third part treats the maximally-flat time-delay networks obtained by the use of Bessel polynomials. In each of these three parts tables of the element values of the normalized low-pass ladder network are given. In the final part it is briefly shown: a. how to transform these networks to serve high-pass, band-pass, or band-elimination functions; b. how to remove the normalization of the element values: that is, how to change the pass band of the network from  $\omega = 1$  to the desired radian frequency, and how to raise the level of the network; c. how to use duality and reciprocity to obtain sets of new networks; d. how to convert the symmetrical Butterworth and Tschebyscheff networks to unsymmetrical ones with any desired ratio of input to output resistance.

# Modern Synthesis

## Network Design From Tables - I

Louis Weinberg, SS Engineer

Hughes Research Laboratories Co., Culver City, Calif.

### Which Network To Use

If a filter is required whose magnitude characteristic is specified, then the Butterworth or Tschebyscheff characteristic may be used. For the same value of  $n$ , the Tschebyscheff filter gives a better coverage of the pass band and a faster drop-off outside the band than any other possible transfer function that is also a constant divided by a polynomial; its phase characteristic, however, is more nonlinear than that of the Butterworth filter. Thus the choice between the two will depend on the importance of the phase characteristic. Neither of these filters gives a linear phase characteristic, that is, a pure time delay, over a specified frequency range. For this purpose the Bessel polynomials are used. The filters obtained by use of the Bessel polynomials also have a low-pass magnitude characteristic so that they may also be used in those problems where the magnitude characteristic is specified.

### Use of the Tables

The general form of the low-pass ladder network whose element values are given in the tables is a lossless network terminated in resistance. In all the tables and in the figures the element values are given in ohms, henrys, and farads. One table gives the values for a resistance termination at the output end only. For networks with resistance terminations at both ends, a number of tables are necessary, each table corresponding to a different ratio of input to output decrement; often a desired ratio of input to output resistance (rather than decrement) is desired, and it is shown how to use the Butterworth and Tschebyscheff tables (for  $n$  odd) to achieve any desired ratio.

The element values are normalized in that the pass band has a cutoff radian frequency  $\omega_c$  equal to unity and the network has a one-ohm resistance load, i.e., in all the tables  $R_1 = 1$ . As will be shown in Part IV the removal of these normalizations requires only simple multiplications. The examples, also, will show how to remove normalizations.

Two general types of inputs are used in practice, a current-source input or a voltage-source input. The circuits for the general ladder, with resistance terminations at both ends and with a current-source input, are shown in Fig. I-1. The transfer function realized by these networks is the transfer impedance  $Z_{21} = E_2/I_1$ . It is observed that both  $a$  and  $b$  of the figure have a shunt capacitance at the load end; in addition, the  $a$  network, which occurs for  $n$  odd, has a shunt capacitance at the input end also, whereas the  $b$  network, which occurs for  $n$  even, has a series inductance at the input end. When the table for a resistance termination at only one end is used,  $R_n$  is not present, that is,  $R_n$  is infinite.

For a voltage source used as the input, the dual of the above networks applies. The general networks are shown in Fig. I-2. Here  $a$  occurs for  $n$  odd and  $b$  for  $n$  even. The transfer function realized by these networks is the transfer admittance  $Y_{21} = I_2/E_1$ . In using the table for the resistance termination at only one end,  $R_n$  is zero.

For networks with resistance terminations at both ends, the *unprimed* elements in the tables correspond to the current-source input networks, Fig. I-1. The *primed* elements correspond to the voltage-source input networks, Fig. I-2. However, this is not true when the network is terminated by a resistance  $R_n$ .

only one end, i.e., when the decrement ratio  $D = 0$ . In this case the unprimed elements correspond to  $Z_{21}$ , (i.e., to a current-source input) only for  $n$  odd; for  $n$  even the unprimed elements correspond to  $Y_{21}$ . The primed elements play the reverse roles: they correspond to  $Y_{21}$  for  $n$  odd and to  $Z_{21}$  for  $n$  even.

For all the low-pass and high-pass transfer functions the number of reactive elements in the network realizations is equal to  $n$ , the degree of the denominator polynomial. This is the minimum possible number that can be used to realize these functions.

The tables for the Butterworth and Tschebyscheff networks are organized on the basis of the decrement ratio  $D$ . However, it is possible by use of the tables to obtain any desired resistance ratio for networks using odd values of  $n$ . Examination of the tables for  $D = 1$  shows that the networks are symmetrical for  $n$  odd; that is, they are mirror images with respect to a vertical center line and thus may be broken into two halves as shown in Fig. I-3 (where a current input has been assumed). Each half has the same transfer impedance and, as seen from the center line, the same driving-point impedance  $Z_a$ . To achieve a resistance ratio  $r = R_n/R_1$  other than unity is simply accomplished: the impedance level of the network on the left is changed by the factor  $r$ . In this way any desired resistance ratio may be realized; i.e., a whole class of new networks is obtained. It will be shown in Part IV that this level change of half of the network does not change the shape of the frequency variation of the over-all transfer function but merely changes its constant multiplier.

### Steps in Solving Problems

1. Determine from the specifications of the problem whether a Butterworth, Tschebyscheff, or Bessel polynomial network is to be used.
2. Calculate the value of  $n$  that gives the required degree of the denominator polynomial of the transfer function and consequently the required complexity of the network. For the Tschebyscheff characteristic it is first necessary to calculate the ripple factor  $\epsilon$ . (Method of calculating  $n$  or  $\epsilon$  is shown in respective sections.)
3. Using this value of  $n$  look up the element values in the appropriate table. For the Butterworth and Tschebyscheff filters a decrement ratio  $D$  is specified for each table. The parameter  $D$  equals  $d_n/d_1$ , the ratio of the input to the output decrement. The decrement is defined in the usual way as the reciprocal of the time constant; for a capacitance at the output  $d_1 = 1/R_1C_1 = 1/C_1$ , since  $R=1$ ; for an inductance  $d_1 = 1/R_1L_1 = 1/L_1$ . Similarly for the input decrement  $d_n = 1/R_nC_n$  and  $d_n = R_n/L_n$ . As explained previously, for resistance terminations at both ends, the unprimed values in the tables correspond to a current input, whereas the primed values correspond to a voltage input. For a resistance only at the load end, however, the unprimed values correspond to a current input for  $n$  odd and to a voltage input for  $n$  even.

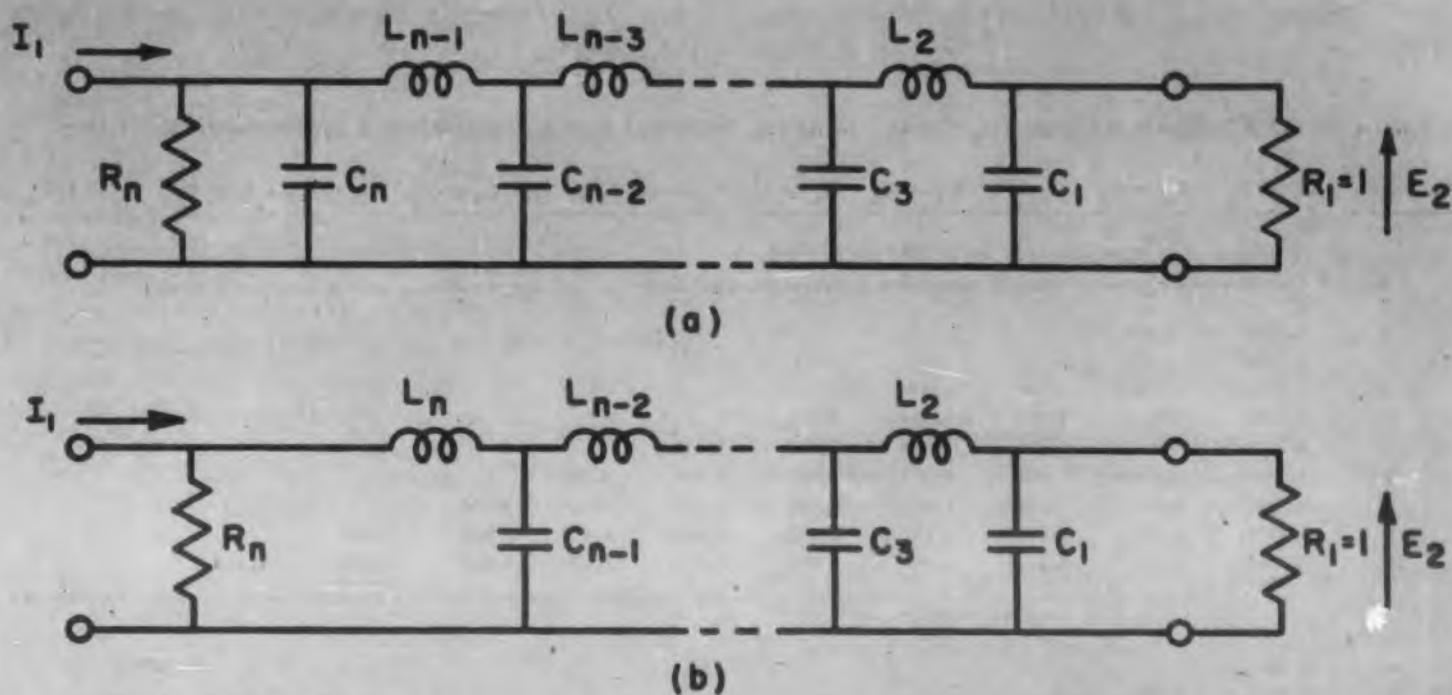


Fig. I-1 General forms of low-pass ladder network with a current-source input and resistance terminations at both ends.

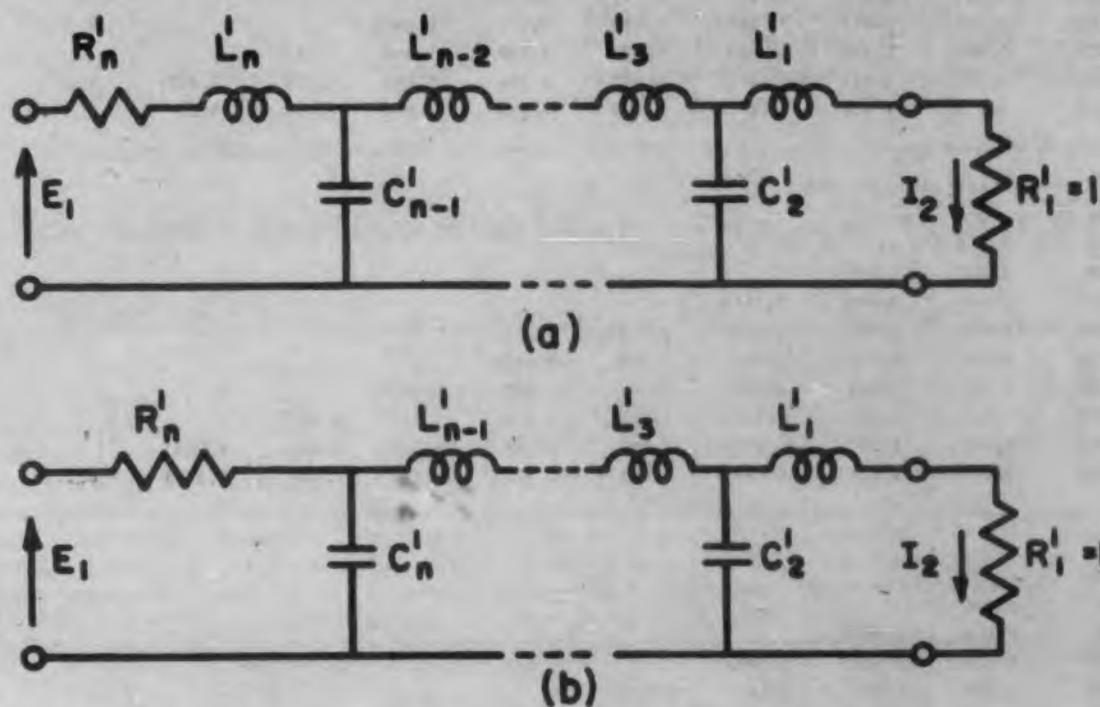


Fig. I-2 General forms of low-pass ladder network with a voltage-source input and resistance terminations at both ends.

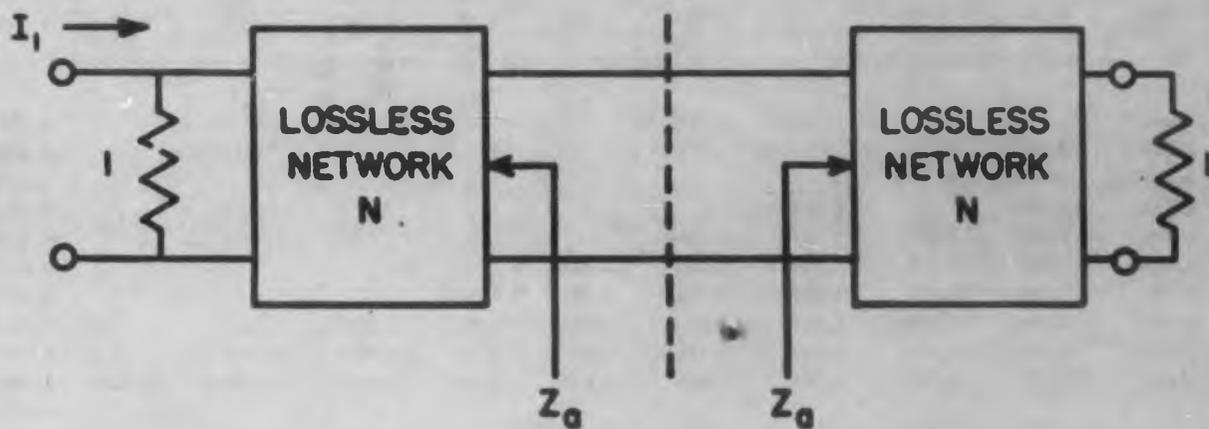


Fig. I-3 Decomposition of a symmetrical network into two network halves.

Table I.1 Element Values (in ohms, henrys, farads) for a Normalized Butterworth Filter

Value of n	C <sub>1</sub> or L <sub>1</sub> <sup>i</sup>	L <sub>2</sub> or C <sub>2</sub> <sup>i</sup>	C <sub>3</sub> or L <sub>3</sub> <sup>i</sup>	L <sub>4</sub> or C <sub>4</sub> <sup>i</sup>	C <sub>5</sub> or L <sub>5</sub> <sup>i</sup>	L <sub>6</sub> or C <sub>6</sub> <sup>i</sup>	C <sub>7</sub> or L <sub>7</sub> <sup>i</sup>	L <sub>8</sub> or C <sub>8</sub> <sup>i</sup>	C <sub>9</sub> or L <sub>9</sub> <sup>i</sup>	L <sub>10</sub> or C <sub>10</sub> <sup>i</sup>	R <sub>n</sub> or 1/R <sub>n</sub> <sup>i</sup>
a) D = 0 (For this case unprimed values correspond to a current-source input for n odd and to a voltage-source input for n even.)											
1	1										
2	0.7071	1.414									
3	0.5000	1.333	1.500								
4	0.3827	1.082	1.577	1.531							
5	0.3090	0.8944	1.382	1.694	1.545						
6	0.2588	0.7579	1.202	1.553	1.759	1.553					
7	2.225	0.6560	1.055	1.397	1.659	1.799	1.558				
8	0.1951	0.5776	0.9370	1.259	1.528	1.729	1.825	1.561			
9	0.1736	0.5155	0.8414	1.141	1.404	1.620	1.777	1.842	1.563		
10	0.1564	0.4654	0.7626	1.041	1.292	1.510	1.687	1.812	1.855	1.564	
b) D = 1/2											
1	1.500										2.000
2	1.061	1.697									0.8000
3	0.7500	1.846	1.393								1.077
4	0.5740	1.557	1.974	1.120							0.9756
5	0.4635	1.307	1.880	1.902	0.9194						1.008
6	0.3382	1.117	1.694	1.983	1.771	0.7743					0.9972
7	0.3338	0.9713	1.515	1.888	1.982	1.630	0.6669				1.001
8	0.2926	0.8578	1.361	1.754	1.974	1.930	1.496	0.5851			0.9997
9	0.2605	0.7674	1.231	1.619	1.892	1.996	1.855	1.376	0.5209		1.000
10	0.2346	0.6937	1.122	1.495	1.788	1.965	1.980	1.770	1.269	0.4693	1.000
c) D = 1 (R <sub>n</sub> or R <sub>n</sub> <sup>i</sup> = 1 for all values of n.)											
1	2.000										
2	1.414	1.414									
3	1.000	2.000	1.000								
4	0.7654	1.848	1.848	0.7654							
5	0.6180	1.618	2.000	1.618	0.6180						
6	0.5176	1.414	1.932	1.932	1.414	0.5176					
7	0.4450	1.247	1.802	2.000	1.802	1.247	0.4450				
8	0.3902	1.111	1.663	1.962	1.962	1.663	1.111	0.3902			
9	0.3473	1.000	1.532	1.879	2.000	1.879	1.532	1.000	0.3473		
10	0.3129	0.9080	1.414	1.782	1.975	1.975	1.782	1.414	0.9080	0.3129	
d) D = 2											
1	3.000										0.5000
2	2.121	0.8485									0.8000
3	1.500	1.714	0.8077								0.9286
4	1.148	1.926	1.596	0.5600							0.9756
5	0.9270	1.886	1.895	1.296	0.4674						0.9918
6	0.7764	1.766	1.989	1.689	1.120	0.3872					0.9973
7	0.6676	1.628	1.984	1.887	1.516	0.9704	0.3341				0.9991
8	0.5853	1.496	1.931	1.974	1.755	1.361	0.8581	0.2925			0.9997
9	0.5209	1.376	1.855	1.996	1.892	1.619	1.231	0.7673	0.2605		0.9999
10	0.4693	1.269	1.770	1.980	1.965	1.788	1.495	1.121	0.6937	0.2346	1.000
e) D = 3											
1	4.000										0.3333
2	2.828	0.5657									0.5600
3	2.000	1.333	0.8571								0.7778
4	1.531	1.702	1.605	0.4502							0.8824
5	1.236	1.834	1.874	1.107	0.4386						0.9394
6	1.035	1.842	1.978	1.509	1.034	0.3345					0.9692
7	0.8901	1.786	2.008	1.747	1.401	0.8561	0.3014				0.9845
8	0.7804	1.704	1.998	1.882	1.635	1.222	0.7727	0.2581			0.9922
9	0.6946	1.611	1.965	1.954	1.787	1.477	1.114	0.6824	0.2324		0.9961
10	0.6257	1.519	1.917	1.985	1.885	1.656	1.363	1.006	0.6200	0.2082	0.9980

4. If the network realizes a Butterworth or Tschebyscheff characteristic and is symmetrical (i.e.,  $D = 1$  and  $n$  is odd), and if a non-unity resistance ratio  $r = R_n/R_1$  is desired, multiply the impedance level of the left half of the network by  $r$ , as shown in Part IV.

5. Remove the normalizations as shown in Part IV. The bandwidth is thus changed from  $\omega_c = 1$  to the desired cutoff value, and the load resistance and the network level are changed to the required values.

6. If a high-pass, band-pass, or band-elimination network is desired, convert the element values by means of the frequency transformations of Part IV.

### Additional Tables

For other synthesis applications the coefficients of the denominator polynomial and its zeros are needed. In fact, the coefficients are also needed even in the ladder networks of this paper for calculating the constant multiplier of the transfer function achieved by the network. In order to gather pertinent information in one place, tables of these values are also given.

### Butterworth Characteristic

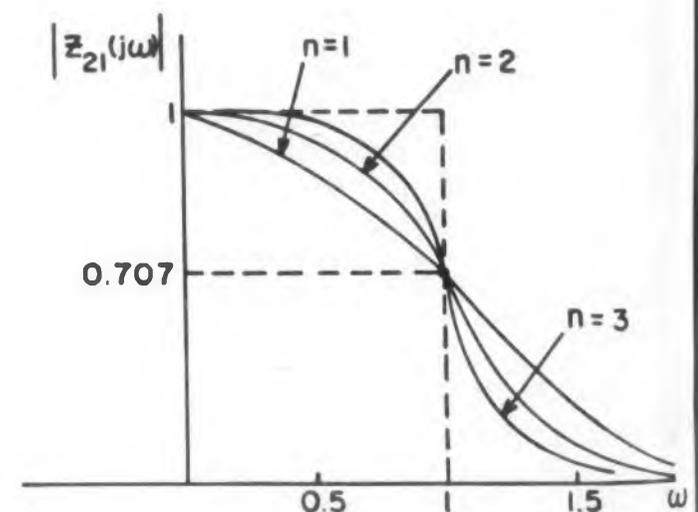
The Butterworth function<sup>1,2,3</sup> is used to approximate the squared magnitude of a transfer function. For the transfer impedance it is given by

$$\left| Z_{21}(j\omega) \right|^2 = \frac{1}{1 + \omega^{2n}} \quad (1)$$

This function gives an approximation to a low-pass filter characteristic; sketches of the Butterworth approximation for the first three values of  $n$  are shown in Fig I-4. The Butterworth function is said to have a *maximally-flat* magnitude characteristic.

By use of Eq. 1 the complete transfer function is given as

$$Z_{21}(s) = \frac{H}{B_n(s)} \quad (2)$$



where  $H$  is a constant multiplier. The polynomials  $B_n$  are called the Butterworth polynomials; their coefficients are given in Table I-2 and their zeros, all of which of course lie on the unit circle, are given in Table I-3.

The element values are given in Table I-1; the resulting networks realize the transfer function within a constant multiplier. To obtain the constant multiplier we let  $s = 0$  in the network and in the transfer function.

### Example

An example of the use of the tables to design a Butterworth filter is presented here.

We wish to design a low-pass filter that has a resistance termination at the output only. The cutoff frequency is  $\omega_c = 10,000$  radians/sec and the output resistance is to be 750 ohms. At a frequency  $\omega = 3\omega_c$  the magnitude response is to be down at least 50 db. The input source is a cathode follower which approximates a true voltage source.

First we determine the value of  $n$ .

$$\left. \frac{1}{1 + \omega^{2n}} \right|_{\omega = 3} = 10^{-5}$$

$$\left. (1 + \omega^{2n}) \right|_{\omega = 3} = 10^5$$

$$3^{2n} \cong 10^5$$

$$n = \frac{1}{2} \frac{5}{\log 3}$$

$$= 5.23$$

The next larger integer  $n = 6$  must be used.

Since no input resistance is required, the table for  $D = 0$  is used, namely, Table I-1a. Since the input is a voltage source and  $n$  is even, the network form of Fig. I-1b (with  $R_n$  omitted) is applicable; that is, the unprimed element parameters are used.

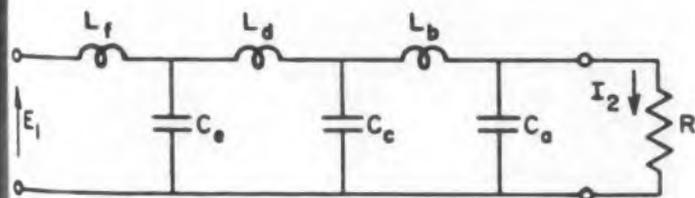


Fig. I-5 Final network achieved for above example.

Fig. I-4. (Shown at Left) Sketches of the first three orders of the Butterworth approximation to the low-pass filter.

Consulting the table yields the element values

$$\begin{aligned} R_1 &= 1 & L_4 &= 1.553 \\ C_1 &= 0.2588 & C_5 &= 1.759 \\ L_2 &= 0.7579 & L_6 &= 1.553 \\ C_3 &= 1.202 \end{aligned}$$

To obtain a load resistance of 750 ohms, we multiply  $R_1$  and all  $L$ 's and divide all  $C$ 's by 750. To change the cutoff frequency to 10,000 rad/sec every  $L$  and  $C$  must be divided by this value.

The final values are therefore

$$R = 750 \quad R_1 = 750 \quad L_d = \frac{RL_4}{\omega_c} = 1.16 \times 10^{-1}$$

$$C_a = \frac{C_1}{\omega_c R} = 3.45 \times 10^{-8} \quad C_c = \frac{C_5}{R\omega_c} = 2.34 \times 10^{-7}$$

$$L_b = \frac{RL_2}{\omega_c} = 5.68 \times 10^{-2} \quad L_f = \frac{RL_6}{\omega_c} = 1.16 \times 10^{-1}$$

$$C_s = \frac{C_3}{\omega_c R} = 1.60 \times 10^{-7}$$

and the network is shown in Fig. I-5.

At  $s = 0$  the network becomes a pure resistance and therefore

$$\left. Z_{21} \right|_{s=0} = \frac{H}{B_6(0)} = R = 750$$

From Table I-2  $B_6(0)$  is 1 so that the constant multiplier  $H$  is 750. The transfer voltage ratio  $E_2/E_1$ , since  $E_2 = 750 I_2$ , is given by

$$\frac{E_2}{E_1} = \frac{1}{B_6(s)}$$

**Acknowledgement:** The author expresses his thanks to the members of the Mathematics Section, Systems Analysis Department, Hughes Aircraft Company, who carried through the calculations for almost all the tables in this paper. This paper is based on Hughes Technical Memorandum 427 "Network Design by Use of Modern Syntheses Techniques and Tables."

### References

- <sup>1</sup>A contribution to the Approximation Problem, R. F. Baum, *Proc. I.R.E.*, vol. 36, pp. 863-869; 1948.
- <sup>2</sup>Cascade Amplifiers with Maximal Flatness, V. D. Landon, *R.C.A. Review*, pp. 347-362; 1941.
- <sup>3</sup>Vacuum Tube Amplifiers, G. E. Valley and H. Wallman, *Radiation Laboratory Series*, vol. 18, Mc Graw-Hill Book Co., New York; 1948.

Table I.2 Coefficients of Butterworth Polynomials  $B_n = s^n + a_{n-1}s^{n-1} + \dots + a_2s^2 + a_1s + 1$

n	a <sub>1</sub>	a <sub>2</sub>	a <sub>3</sub>	a <sub>4</sub>	a <sub>5</sub>	a <sub>6</sub>	a <sub>7</sub>	a <sub>8</sub>	a <sub>9</sub>
1									
2	1.4142136								
3	2.0000000	2.0000000							
4	2.6131259	3.4142136	2.6131259						
5	3.2360680	5.2360680	5.2360680	3.2360680					
6	3.8637033	7.4641016	9.1416202	7.4641016	3.8637033				
7	4.4939592	10.0978347	14.5917939	14.5917939	10.0978347	4.4939592			
8	5.1258309	13.1370712	21.8461510	25.6883559	21.8461510	13.1370712	5.1258309		
9	5.7587705	16.5817187	31.1634375	41.9863857	41.9863857	31.1634375	16.5817187	5.7587705	
10	6.3924532	20.4317291	42.8020611	64.8823963	74.2334292	64.8823963	42.8020611	20.4317291	6.3924532

Table I.3 Zeros of Butterworth Polynomials  $B_n$

n=1	n=2	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
-1.0000000	-0.7071068	-1.0000000	-0.3826834	-1.0000000	-0.2588190	-1.0000000	-0.1950903	-1.0000000	-0.1564345
	$\pm j0.7071068$		$\pm j0.9238795$		$\pm j0.9659258$		$\pm j0.9807853$		$\pm j0.9876883$
		-0.5000000	-0.9238795	-0.3090170	-0.7071068	-0.2225209	-0.5555702	-0.1736482	-0.4539905
		$\pm j0.8660254$	$\pm j0.3826834$	$\pm j0.9510555$	$\pm j0.7071068$	$\pm j0.9749279$	$\pm j0.8314696$	$\pm j0.9848078$	$\pm j0.8910065$
				-0.8090170	0.9659258	-0.6234898	-0.8314696	-0.5000000	-0.7071068
				$\pm j0.5877852$	$\pm j0.2588190$	$\pm j0.7818315$	$\pm j0.5555702$	$\pm j0.8660254$	$\pm j0.7071068$
						-0.9009689	-0.9807853	-0.7660444	-0.8910065
						$\pm j0.4338837$	$\pm j0.1950903$	$\pm j0.6427876$	$\pm j0.4539905$
								-0.9396926	-0.9876883
								$\pm j0.3420201$	$\pm j0.1564345$



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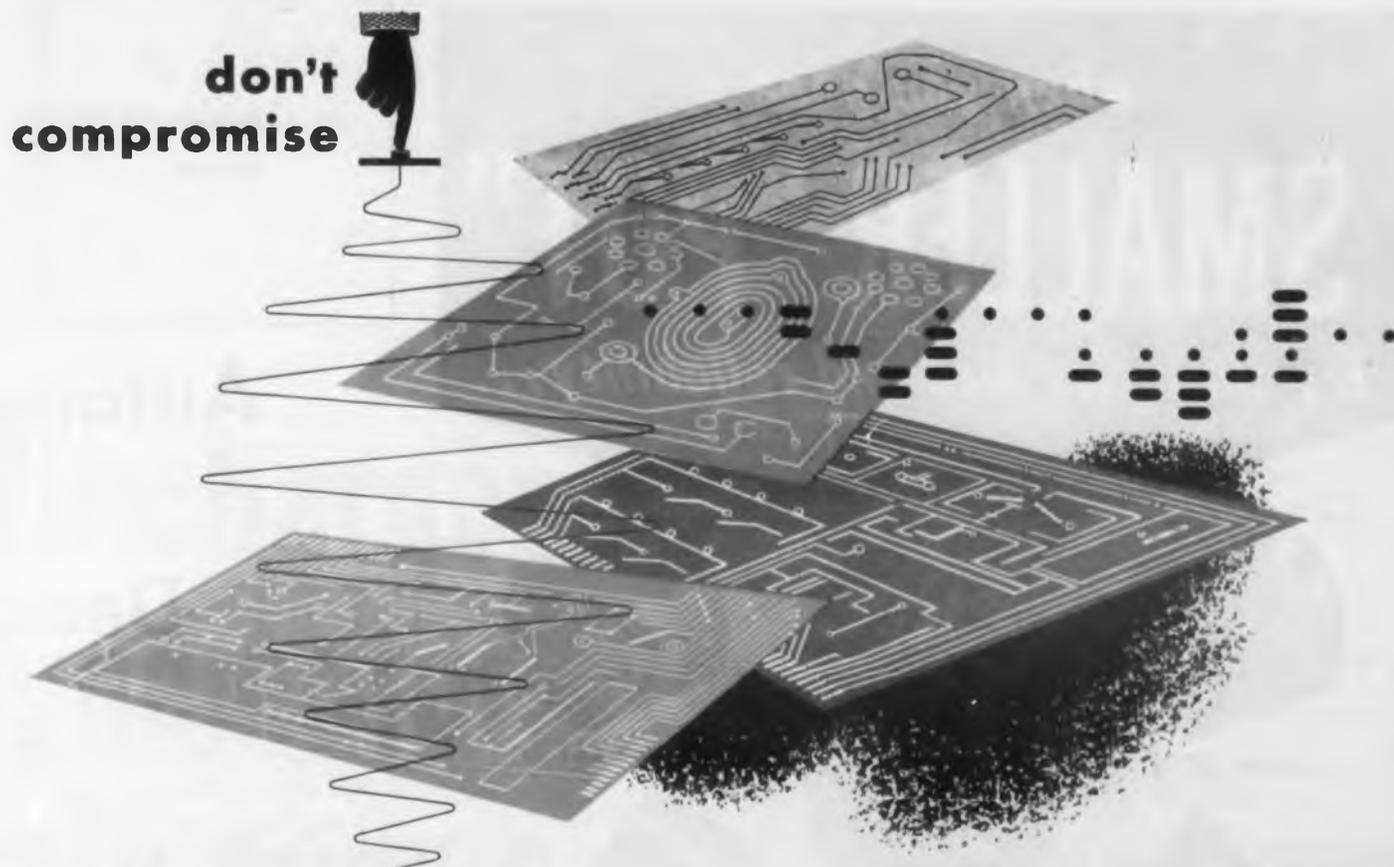
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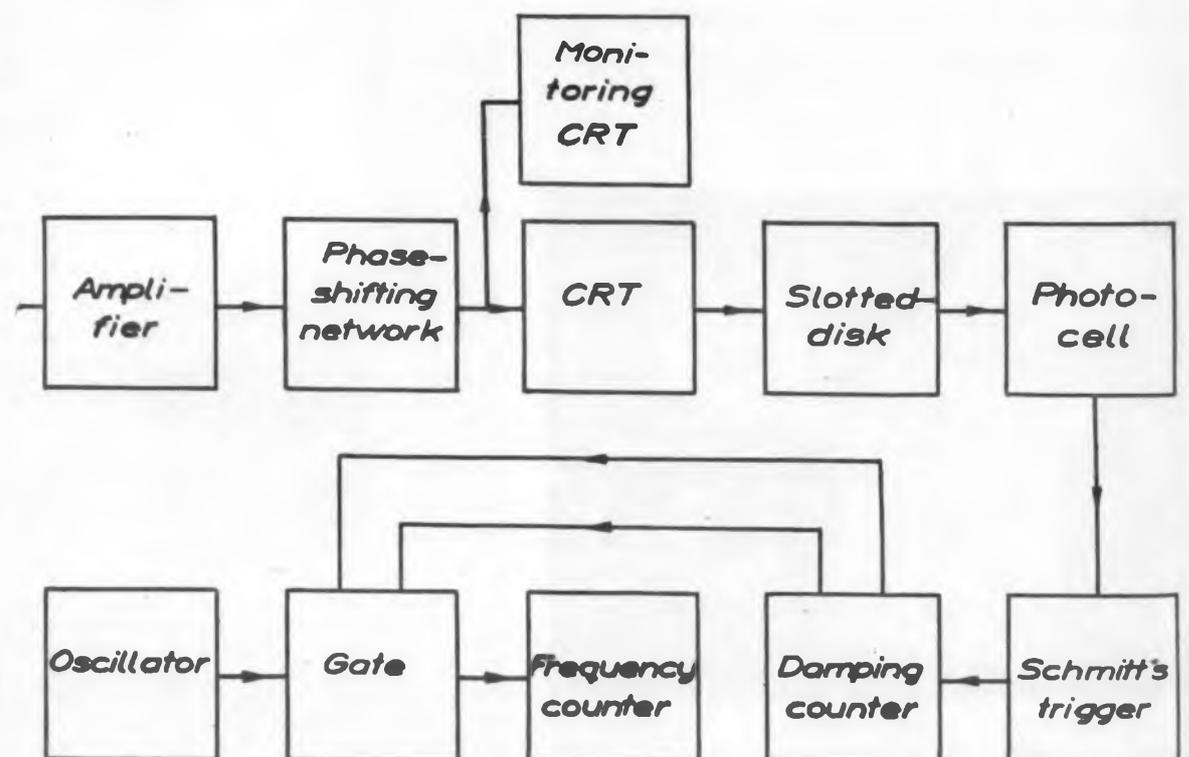
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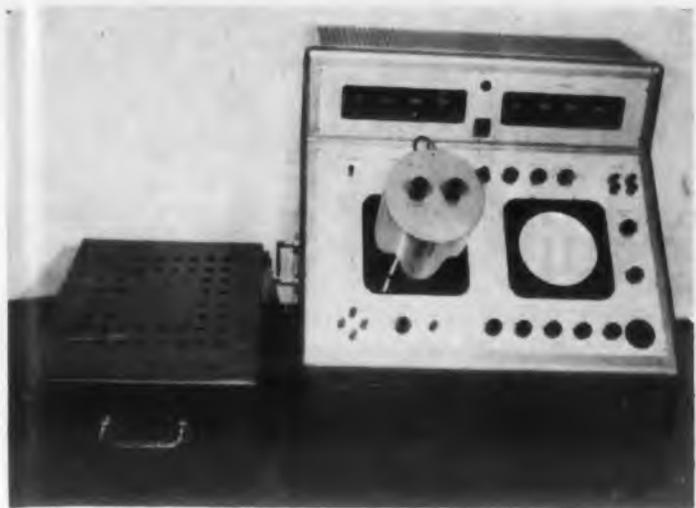
First problem in the design of the device was to convert the oscilloscope trace of a damped oscillation into a form that

may be "read." Designer of the instrument, Carl Olsson of Sweden, converted the damped oscillation into a rotating vector appearing as a rotating spot on the oscilloscope screen. Velocity of rotation of the vector is directly proportional to the frequency of the oscillation; length of the radius vector represents amplitude.

Rate of rotation and vector length are transformed into a series of light pulses, then into voltage pulses. A radially-slotted disk placed over the oscilloscope screen breaks the rotating spot into a series of light pulses. These light pulses are picked up by a multiplier phototube, converted by proper circuitry into voltage pulses to be shaped, and counted. Pulses are counted by



Block diagram of the Dampometer.

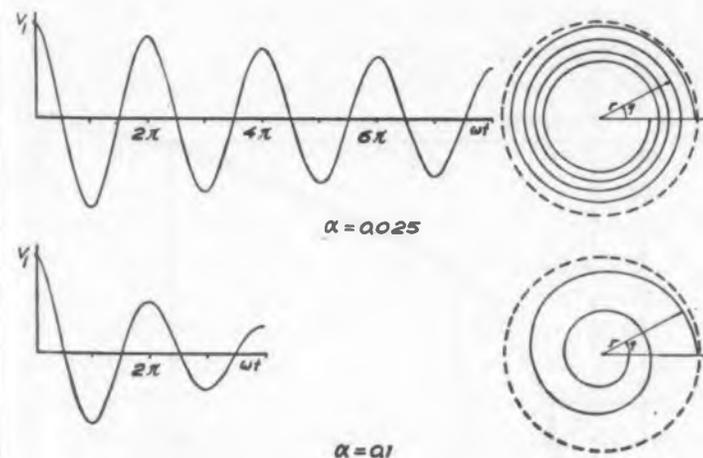


a damping counter consisting of the necessary trigger tubes and electrostatic, high-vacuum decade counter tubes.

Frequency of oscillation is measured by comparison with the frequency of an R-C oscillator. A frequency counter similar to the damping counter counts the number of cycles of the R-C oscillator between two selected light pulses.

Results are presented on the counter tubes on the panel of the instrument. One group records logarithmic decrement of damping, the other records frequency. Applications of the unit include wind tunnel installations for aerodynamic testing, and solution of problems in acoustics and electronic circuits.

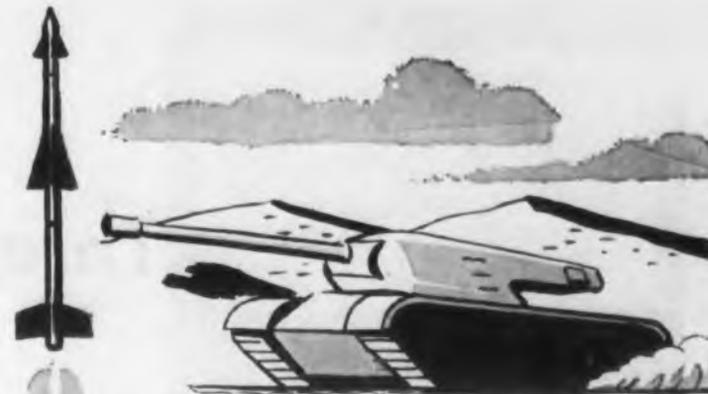
# Wincharger dynamotors help power the nation's defense



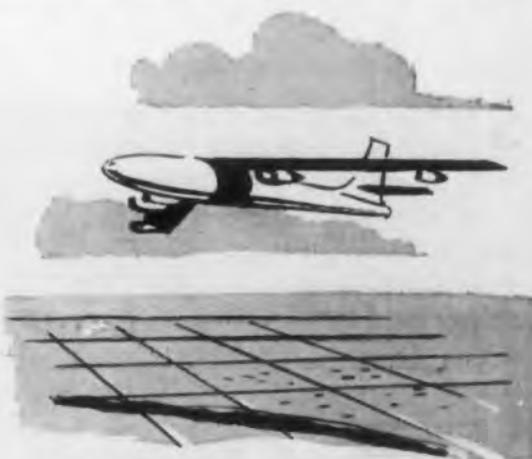
Typical damped oscillations and their representation as a logarithmic spiral.



Radially-slotted disk placed over the oscilloscope screen breaks up the rotating vector into light pulses.



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# Three-Dimensional Cam Circuit

**Max Fogiel**  
Ford Instrument Co.  
Long Island City, N.Y.

**S**OME computers require a three-dimensional cam when it is necessary to obtain an output  $Z$  which is a function of two variables  $x, y$  such as  $Z = f(x, y)$ .

An electronic circuit, described in this article, will develop an output which is a function of two variable inputs and effectively replaces the mechanical three-dimensional cam.

The circuit is based on the principle that a linear potentiometer may, by connecting proper tap resistors to it, be converted to one which will have an output voltage proportional to a nonlinear function. For a given arrangement of tap resistors and potentiometers, the output will be proportional to a given function of shaft position  $x$ . To change the characteristics of the function it is necessary to change the tap resistors.

Consequently, where the output  $Z$  is a function of both  $x$  and  $y$ , the characteristics of function  $x$  depend upon  $y$ . Therefore it is necessary to vary the values of the tap resistors in accordance with the demands arising out of the variations in  $y$ .

Variation of tap resistors with  $y$  is accomplished by rotating a number of potentiometers by the quantity  $y$ , Fig. 1. One potentiometer is provided for each tap resistor.

In determining the values of the resistances, the first step is to draw a curve of output  $Z$  versus shaft rotation of the  $x$ -axis potentiometer for a fixed value of  $y$ , Fig. 2. This curve represents a cross-section of the 3-D cam at point  $y$ . A similar curve can be drawn of output  $z$  versus shaft position of the  $y$ -axis poten-

tiometer for a fixed value of  $x$ .

To find the location of the tap points, a series of straight lines are superimposed on the curve closely approximating the curve. Each intersection of the lines, Fig. 2, is a tap point. Accuracy, of course, is increased by drawing more lines which result in more taps.

Resistance between taps is proportional to the distances  $a, b, c$ , and  $d$  on the  $x$ -axis. For example,  $R_1 : a$ ,  $R_2 : b$ , etc. Potentiometers  $x$  and  $y$  may be represented by the circuit of Fig. 3a. To calculate actual values, it is necessary to work from the equivalent circuit, Fig. 3b. Values for the equivalent resistances may be calculated when the load resistance,  $R_L$ , the reference voltage and the output voltage at any tap of the

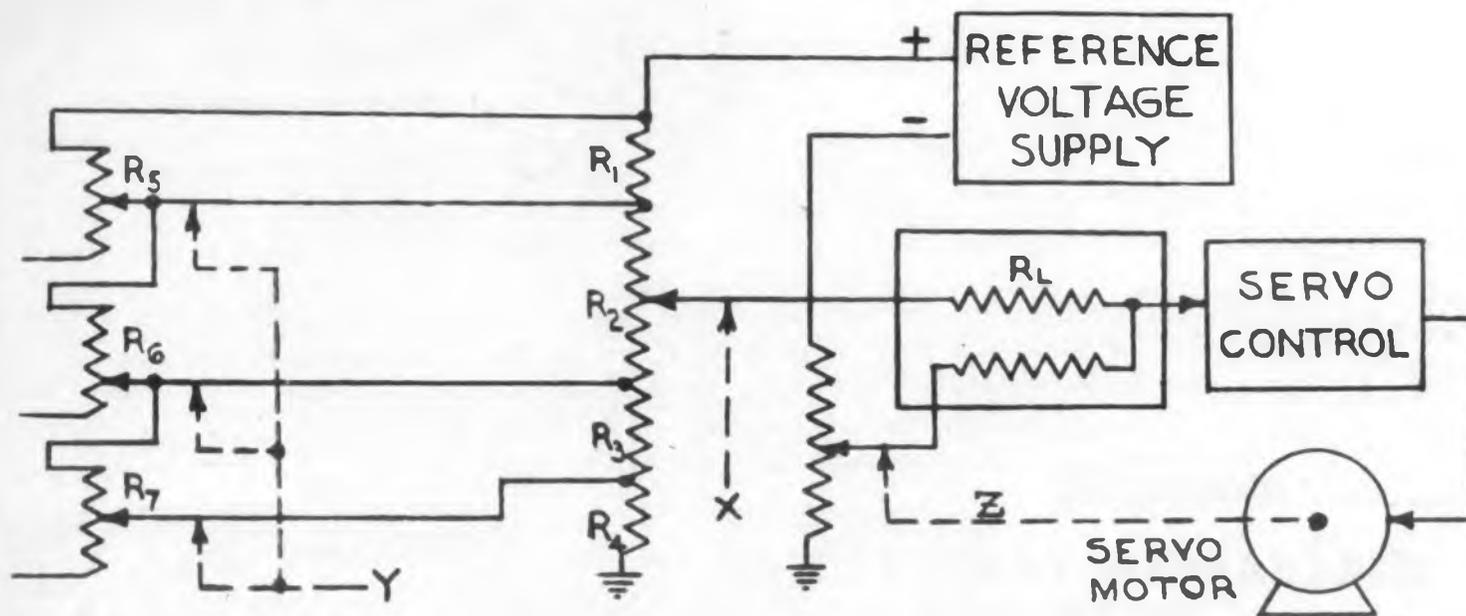


Fig. 1. Simplified circuit diagram of an electrical three-dimensional cam.

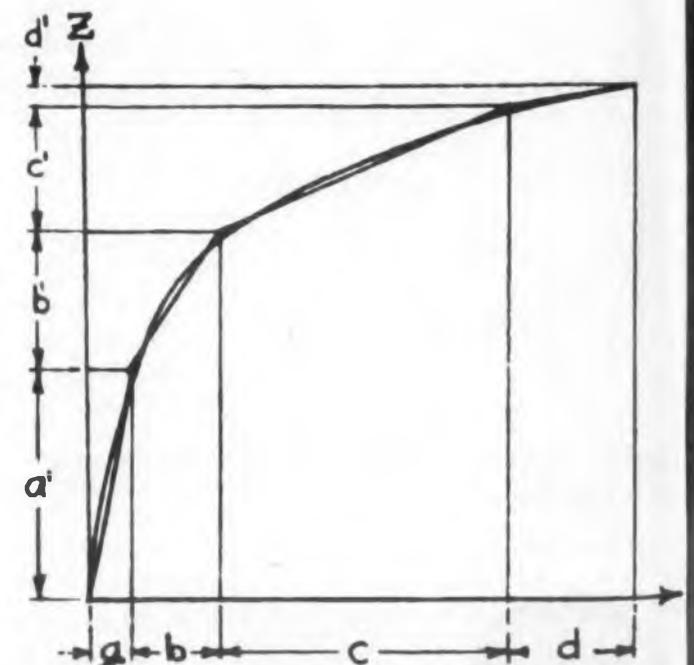


Fig. 2. Shaft rotation  $x$  versus output  $Z$ . This curve represents a cross-section of a three-dimensional cam at a point  $y$ .

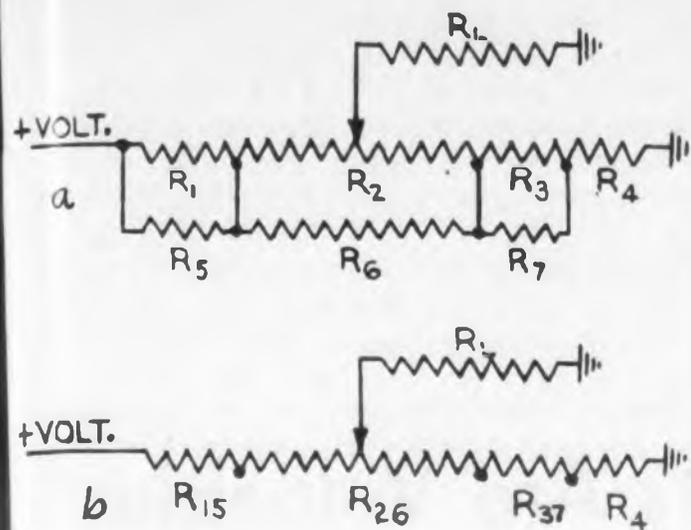


Fig. 3. Heart of the three-dimensional cam circuit is the tapped potentiometer (a). Its equivalent circuit, (b), is used to calculate resistance values between taps.

...axis potentiometer are known. For example, the equivalent resistance  $R_{37}$  determined by the relation:

$$R_{37} = \frac{1}{2} \left[ \left( R_t - \frac{R_L}{d'} \right) + \sqrt{\left( \frac{R_L}{d'} - R_t \right)^2 + 4 R_L R_t} \right] - R_4$$

where

$$R_t = \frac{R_4 \left( \frac{a'}{d'} R_4 + R_L \right)}{\frac{a'}{d'} (R_4 + R_L)}$$

and is the total equivalent resistance for the voltage reference supply.

Having evaluated  $R_5$ ,  $R_3$  and  $R_{37}$ , is it possible to compute the  $R_7$ , the value of the  $y$ -axis potentiometer. It is possible to insert either potentiometers having the required functional windings, or tapping linear potentiometers and connecting the required parallel resistors across these tap points. The magnitude of these resistors are readily computed from the condition that the equivalent parallel combination must equal the corresponding value of the preceding tap resistors. These resistors may be of the fixed type, or variable resistors may be set to the correct value.

Electrical output  $Z$  may be converted to mechanical form by connecting the output to the signal leg of a nulling or summing network, and the feedback leg of this network to a linear potentiometer whose applied voltage is oppositely directed to that of  $x$ -axis potentiometer. The servo motor will drive and position a potentiometer so that the magnitudes of the currents in both legs of the network are equal. In this manner the shaft position of the potentiometer will be proportional to the quantity  $Z$ . With the output  $Z$  thus established in the form of a mechanical quantity, the circuit of Fig. 1 is a direct and effective electrical substitute for three-dimensional mechanical cams.

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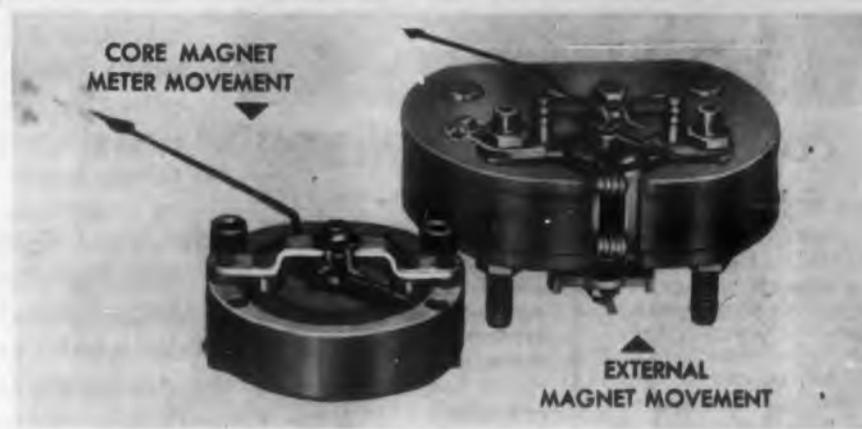
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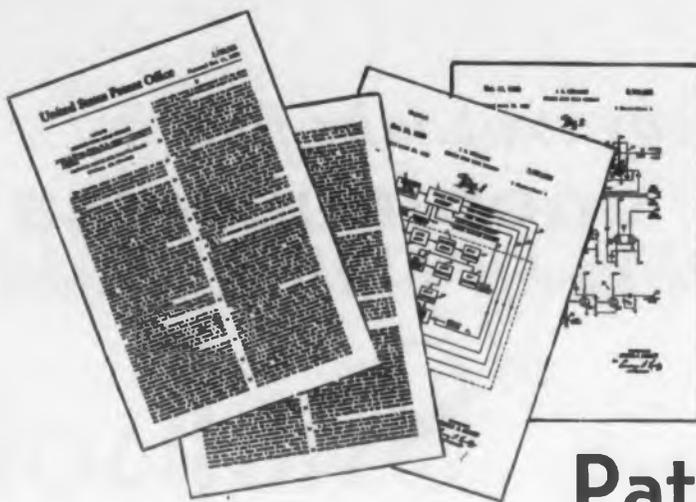
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## Patents Are Valuable

Matthew Russo

685 Alabama Ave., Brooklyn 7, N.Y.

This article is in response to one by Mr. Raymond C. Miles, "What Good Are Patents", which appeared in the May 15th issue of ELECTRONIC DESIGN. The present article "Patents Are Valuable," is intended to refute some of the contentions raised by Mr. Miles, and to present, according to the author, "a more thorough and complete picture of the patent system in general." Mr. Russo, a patent consultant, has been active in the field of patent sales promotion.

INVENTIONS have been responsible for raising man's standard of living. As an encouragement to invention, there has developed a concept of property rights known as the "patent system." Basically, the patent system was designed to assure the development of new things which would react favorably upon the economy. It is a means of promoting the progress of science and useful art. "Invention" involves the bringing forth of some new idea which, when reduced to practical usage, will satisfy some want or desire, either latent or previously experienced. It is not limited to developments in the physical sciences or industry, but applies to all creative intellectual endeavor.

### Classifications of Inventions

The importance of an invention depends upon the end result. Sometimes the result satisfies an intense want of many people; yet, sometimes it is of little usefulness to society, satisfying the wants or needs of the originator or inventor only. Based on the importance of the end result, inventions may be classified as: Basic or extensive inventions; developmental or intensive inventions, and minor inventions.

*Basic Inventions.* Revolutionary results flow from basic or extensive invention. Inventions of printing, telecommunications, explosives, the aeroplane, and the steam boat are examples. When such great develop-

ments are first presented to the public, they are usually deprecated and under-valued; the inventor is often considered a dreamer or a dangerous person to be suspected or shunned. Before full commercial advantage can be taken of the invention, inertia and apathy must be overcome.

*Developmental Inventions.* Original inventions are so basic and extensive in character as to require much further development and improvement. Most inventions today are of the developmental or intensive type which add to or improve existing inventions.

*Minor inventions* result in the production of gadgets, of which there are many. Socially, such inventions are of distinctly minor importance, though they are of great consequence to the inventor, particularly during the first rush of enthusiasm that besets him upon becoming an inventor.

From the standpoint of complexity there seem to be two extremes in the scale of invention. The simple "gadget" type requires relatively little scientific knowledge for its conception and limited capital for its exploitation; whereas, the more complicated invention requires extensive scientific knowledge and considerable capital to bring it to the point of even a successful commercial demonstration.

### Motivating Factors

The prospect of income or profits from the marketing of inventions motivates inventors. An influx of inventive talent is attracted to a particular field when developments in the field offer good prospect of financial reward. When patent laws were first drawn, inventions and discovery were almost exclusively the product of the efforts of individuals working alone. Today invention and discovery are largely the work of research laboratories. It is estimated that 60 per cent of patents now go to corporations and only 40 per cent to individuals.<sup>1</sup> As a result, the independent inventor

is continually finding it more difficult to defend and market his own inventions. In this respect, Mr. Miles stated that patents are seldom considered a potential avenue to personal wealth and that the large proportion of patents are issued to individuals working for a salary. I would like to answer this contention by the following observations:

Except for a few minor areas of business activity, the industrial and technological economy of today bears little resemblance to that of yesterday. The relatively simple, easily understood and inexpensive inventions have given way to highly complex inventions that require extensive scientific training to understand and substantial experimentation and capital to perfect and develop. The "garage" inventor has given way, to a marked extent, to the coordinated group activity of the research laboratory. Therefore the fault does not lie with the patent system, but with the gradual evolution of our economy.

The contention that a salaried design engineer who invents something receives only \$1 to \$100 for the assignment of his invention, is not quite accurate and requires examination. Such an individual, after all, is being paid a salary either to do research or invent; and if incidental to his employment, he invents something, it is only fair and equitable that his invention be considered a natural consequence of his employment. Therefore, any extra consideration from his employer for this effort should be considered fair. Furthermore, it is to be expected that an individual who invents many devices which his firm patents, will in time be promoted to a position of greater responsibility, resulting in a higher salary.

Inventors must also consider the market investment and business hazards involved in marketing any invention—whether a new product, a new machine, or a substantial improvement. If an invention is not profitable, the fault by no means lies with the patent system; although a prerequisite to obtaining a patent is that the device be new and useful, there is no requirement that the particular device be commercially practicable. Many individual inventors waste time and money filing patent applications that should never have been filed, and in trying to exploit unprofitable inventions. This happens because of a lack of technical background or business sense. An inventor who undertakes to exploit his own invention often lacks necessary managerial ability. This is attested by the relatively high salaries capable business managers are able to command.

Notwithstanding unfortunate experiences of many, the individual inventor working in a field in which he has technical competence and directing his efforts towards the current problems in the field, performs a vital and important function. The patent system is designed to encourage this type of inventor. There are many aids of which the independent inventor should take advantage before filing a patent application. Once a patent is granted there is still no assurance that the invention will be a financial success. The Small Busi-



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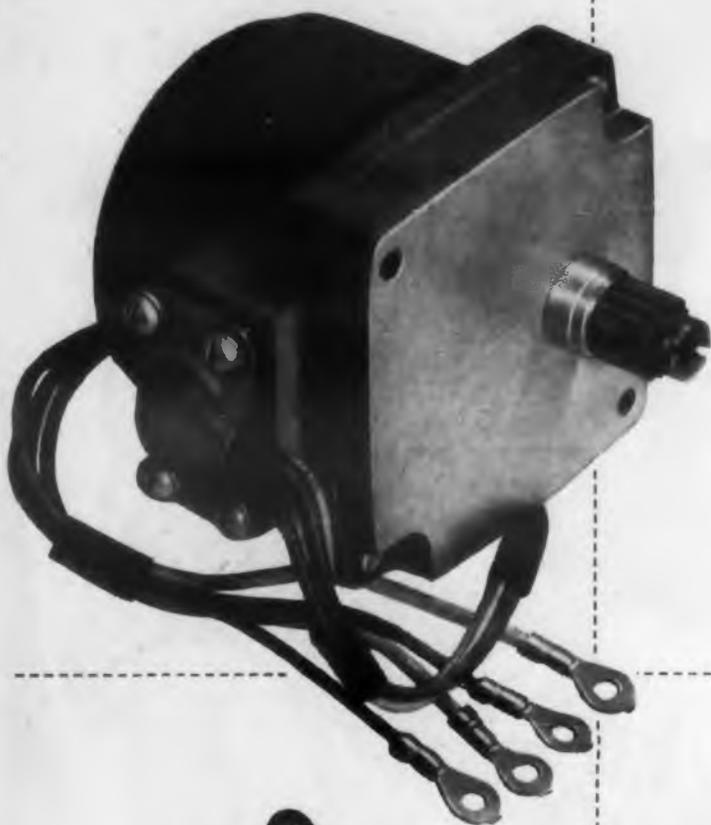


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Rated torque—in. oz.	30	15	5	4	5
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ness Administration, the Office of Technical Service of the Department of Commerce, and the National Research Council are typical of many organizations which will aid and advise inventors of the potentials of their inventions. The commercial success of a patent frequently depends on many factors, such as marketing, advertising program employed, the management personnel, and even the location of the business.

**Monopoly of a Patent**

A patent is the reward for invention or discovery of something new, something added to the sum total of human knowledge, something which the inventor might withhold from his fellow man. By granting a patent, the Government protects the inventor for a limited time. A patent awards a temporary monopoly to the inventor—the right to exclude others from making, using, or selling the invention (as claimed) until the patent expires. Mr. Miles stated that a patent only represents the exclusive right to the use of an invention, but neglected to add that it also gives the inventor the right to preclude others from making or selling the patented item. This is of extreme importance. If a competitor not only knows of an invention but also of an intent by the inventor to patent it, this normally discourages infringement.

In this country, the right to obtain a patent is an absolute right for the benefit of the inventor. This is not so in many foreign countries where the granting of the patent right is not quite so absolute and is surrounded by many conditions. As a result, it is my sincere opinion that this country provides, by its unconditional patent monopoly, the greatest stimulus to invention that exists anywhere in the world.

**The Meaning Of A Claim**

There is probably no class of writing requiring more skill or perception than the drafting of patent claims, and certainly none more intriguing. Within a few lines must be condensed the substance contained in many lines and pages of descriptive text. But patent claims must do considerably more than merely abridge the description of the invention appearing in the specification of the patent. The real purpose of the claim is to fix the extent of the monopoly granted by the patent, i.e., to define precisely what is the thing which exclusively belongs to the inventor. The specification merely describes the invention; but one must look to the claims to determine what actually constitutes the invention protected by the patent. The claims must not only be descriptive and inclusive (metes and bounds of the invention) but they must also be distinctive (e.g. patentably differentiated by prior devices or art).

Mr. Miles has made the contention that few patents pass the test for really top-notch protection, since either the claims are weak or the invention is not fundamental. He also contends the possibility of direct income from patents is not attractive to electronic



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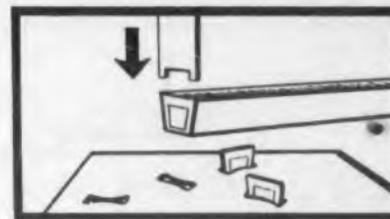
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● "Wejcap" Capacitors represent the lowest possible unit cost for comparable quality in capacitor components and offer perfect adaptability to low-cost high volume production methods.

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firms. A study of the record—substantiated by hearings on the American patent system before the 84th Congress at which representatives of 500 of the largest corporations discussed their views on the merits of the patent system—leaves the impression that Mr. Miles contention is not quite correct. These representatives discussed the potential worth of patents to their respective corporations. It was clearly indicated that patents still afford a great protection from competition and, where the patents are for labor-saving devices, a great improvement in operating efficiency of mass production systems. Many of these firms alleged that the success of their corporations was based mainly on the strength of their patents. Manufacturers in various industries cited specific examples of how patents, both of the fundamental or improvement type, provided the inspiration that resulted in the vast progress of their firms.

Another interesting observation brought out by some of the corporate representatives was the fact that engineers who have an understanding of patents are provided with a powerful engineering tool. This is because patents are the source material of past engineering development and indicative of present engineering trends. Patents available for reference at the U.S. Patent Office in Washington, D.C., afford an engineer a review of a century and a half of engineering progress in any field. From a company standpoint, the engineer who understands patents is a valuable man because he is in a position to steer the company clear of the staked-out areas of the patented inventions of others. If the engineer is familiar with the prior art and his competitors' patents, he will be able to protect his company from possible liability arising out of infringement. It is, therefore, a good idea for the engineer to become familiar with the patents; the earlier the better, because he will find that patent knowledge is predominantly gained by experience and not from textbooks.

The patent system was not intended to afford protection to private parties against the copying by others of new products which involve only improvements normally to be expected in the orderly course of product development. The primary purpose of the patent system is to promote the progress of science and the useful arts. This purpose is achieved by acquainting the public with advances requiring more than ordinary ingenuity and by keeping alive the disclosures others have made in the past. The reward which the inventor hopes for, and which furnishes him with an incentive to invent and disclose his inventions, is not directly provided for by the patent law. It merely establishes conditions favorable to exclusive exploitation of an invention by its owner for a limited period of time. The reward must be earned by commercial exploitation of the invention, or obtained by sale of rights to someone who believes he can make profits by virtue of possession of such rights.

Hearings. Amer. Patent System ptl 84 Cong. p925

CIRCLE 27 ON READER-SERVICE CARD FOR MORE INFORMATION

# Ceramics and Design\*

Harold W. Huffcut  
Westinghouse Electric Corp.  
Elmira, N. Y.

**C**ERAMICS find wide application in electron tube design, and the developments in this area should be of interest to designers working on other electronic design activities as well. The ceramics field is much broader than is generally realized. The American Ceramic Society divides the field into eight parts—abrasives; art ware; cements, lime, and plaster; enamels; glass; structural clay products; refractories; and whiteware.

## ► Glasses

Of these, glass is the most used in electronics. One of its main uses has been for envelopes in the vacuum tube industry. It has excellent working characteristics, as it can be shaped or molded into almost any form. Also, there are so many different glass compositions, each with its own characteristics and properties, that a glass can be found suitable for almost any purpose. The principle limitations of glass are its fragile nature and its low-temperature softening point which limits the operating temperature of the tube.

Glasses vary in their expansion characteristics as do metals; hence, proper matching to metals in glass-to-metal seals is very important. In general, glasses have a higher rate of expansion at higher temperatures. Soft glasses have higher expansion characteristics than hard glasses.

Glass bulbs vary in size from those required for subminiature receiving tubes to those required for the large TV tubes and in composition from soft glass to hard glass. The trend in design is away from large bulky bulbs and toward smaller bulbs with straight sides. Soft glass has already been replaced by hard glass in most power tubes to accomplish higher temperature bake-out operation and improved electrical properties.

## Electrical Conduction Through Glass

In most tubes it is necessary to provide a method of conducting electrical current to the element inside the tube while maintaining a good vacuum at operating

temperatures to 300 C. Metal is a good conductor; thus, the method employed is glass-to-metal seals, with metal leads protruding through the glass.

When metal leads are brought into the glass, an expansion mismatch can be tolerated if the leads are small enough. In all cases the glass and metal must be brought to at least red heat so that the glass can be softened sufficiently to wet the metal. For mass production of seals, the matching of glass to metal is most important.

## Housekeeper Seal

Since in practice it is sometimes difficult or impossible to match glass to metal, various adaptations of what is commonly called the "housekeeper seal" are made. Thin sections of some metals yield to expansion of the glass because of their ductility and low yield point. When thin sections of soft metals are bonded to glass, the matching expansions are unnecessary. A common "housekeeper seal" method is to bead a thin copper section with glass and then seal to tubing of a matching glass. The thin section of the copper conforms to the expansion of the glass without over-stressing the glass.

## Pre-Glassing

Improper adherence of glass to metal can be overcome by pre-glassing the metal. An example of this is

evident in color tv face panels. One type of seal uses porcelain enamel (a glass) applied to the metal, with subsequent glass face-plate sealing to the porcelain enamel. Another similar example is the pre-glassing of Kovar so it will not become over-oxidized during further processing.

When a glass and a metal must be sealed together and they have different expansions, graded seals can be used. A glass that matches the metal will be sealed to the desired glass in steps. The steps are usually different in expansion by a maximum of 7 points in the coefficient of expansion. An example is shown in Table I where a No. 7720 glass bulb with a coefficient of 36 is matched to Kovar which has a coefficient of 50. Two steps are used in-between as indicated.

Table I Step-Seal Example

Metal & Expansion Coef.	Step Glasses		Glass Bulb
	#1	#2	
Kovar 50	#7052 46	#3320 40	#7720 36

\* Based on a paper "New Uses of Ceramics in the Electronic Tube Industry" presented by Mr. Huffcut at a regional AIEE Meeting, April 17, 1956, in Fort Wayne, Ind.

Table II

Ceramics Trade Name	Tensile Strength lbs/sq in.	Impact Resistance ft-lbs	Hardness Moh's Scale	Safe Operating Temperature—Deg C
Alumina	18,000 to 25,000	6.5 to 7.5	9	1400
Zircon	10,000 to 12,000	5.0	8	1600
Steatite	10,000	4 to 5	7.5	1000
Forsterite	10,000	4.0	7.5	1000

### Metallizing

Another glass-to-metal seal is accomplished by metallizing the glass. This can be done by applying the metal in the form of a suspension in oil. The metals diffuse in the glass at high temperatures in an oxidizing atmosphere, but with sufficient metal remaining on the surface to permit bonding to solder. Use of glass flux assists in the bonding. They are then electroplated with copper and ready for further soldering. These seals cannot be operated at high temperatures.

### Miscellaneous Methods

Another method of applying metal to glass is by spraying of hot metal on the glass or ceramics at 200-400 C, using a sloop metallizing gun.

A small amount of metal can also be applied by transferring metal to a rotary steel brush, from which it is rubbed onto the ceramic or glass.

Solder-glass sealing is helpful where there is danger that heat might damage components of the tube. Parts currently being sealed with solder glass range in size from hearing aid components to color TV panel-to-tunnel seals. Solder glasses with softening points in the range of 400 C are available for such uses. These glasses will even seal to mica, other glasses, and aluminum.

### ► Whiteware Ceramics

The need for still higher operating temperatures, use of higher frequencies and higher power levels pointed to the use of whiteware bodies, commonly called "ceramics." The wide variety of ceramics with varying properties offer broad possibilities for application. Most commonly used ceramics are given in Table II.

High-purity *alumina* ceramic parts are valuable for their high safe operating temperature, low loss factor, high strength and non-gassy condition. They are readily outgassed at high bakeout temperatures, and they assure harder and more permanent vacuums. Surface finishes can vary from an unglazed as-fired condition to a glazed, ground and lapped condition. Glazes can be supplied in white or colors with a smooth surface that can readily be wiped clean. Tolerances of parts are becoming closer, especially by grinding. The high purities available have reduced the doubt of probable contamination.

Methods of forming ceramics have also advanced. For instance: extrusion of tubing with two holes can be made so small that the holes can barely be seen with the naked eye. Pieces can be threaded internally or externally to fit standard screw sizes. Blind holes can be tapped or left plain. Grinding methods have been improved to allow almost any shape to be made. Alumina can be readily metallized and, when brazed to metal, results in a high-strength vacuum-type bond.

Fabrication of alumina ceramics is relatively simple, allowing a size range from a fraction of an inch to 12 in. diam and lengths to 18 in. For use as windows, thicknesses down to 0.010 in. have been produced.



### Here's One Reason Why You Should Know About AMP Terminals

AMP meets the requirements of modern business machine and computer manufacturers for reliable, miniature wire terminations which can be installed at high speed. As the complexity of circuits and number of terminations increases, so must the dependability, efficiency and ease of application increase. AMP is constantly working to develop better and better solderless wiring to meet these requirements.

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*Have your name put on the AMP mailing list to receive valuable information about these developments.*

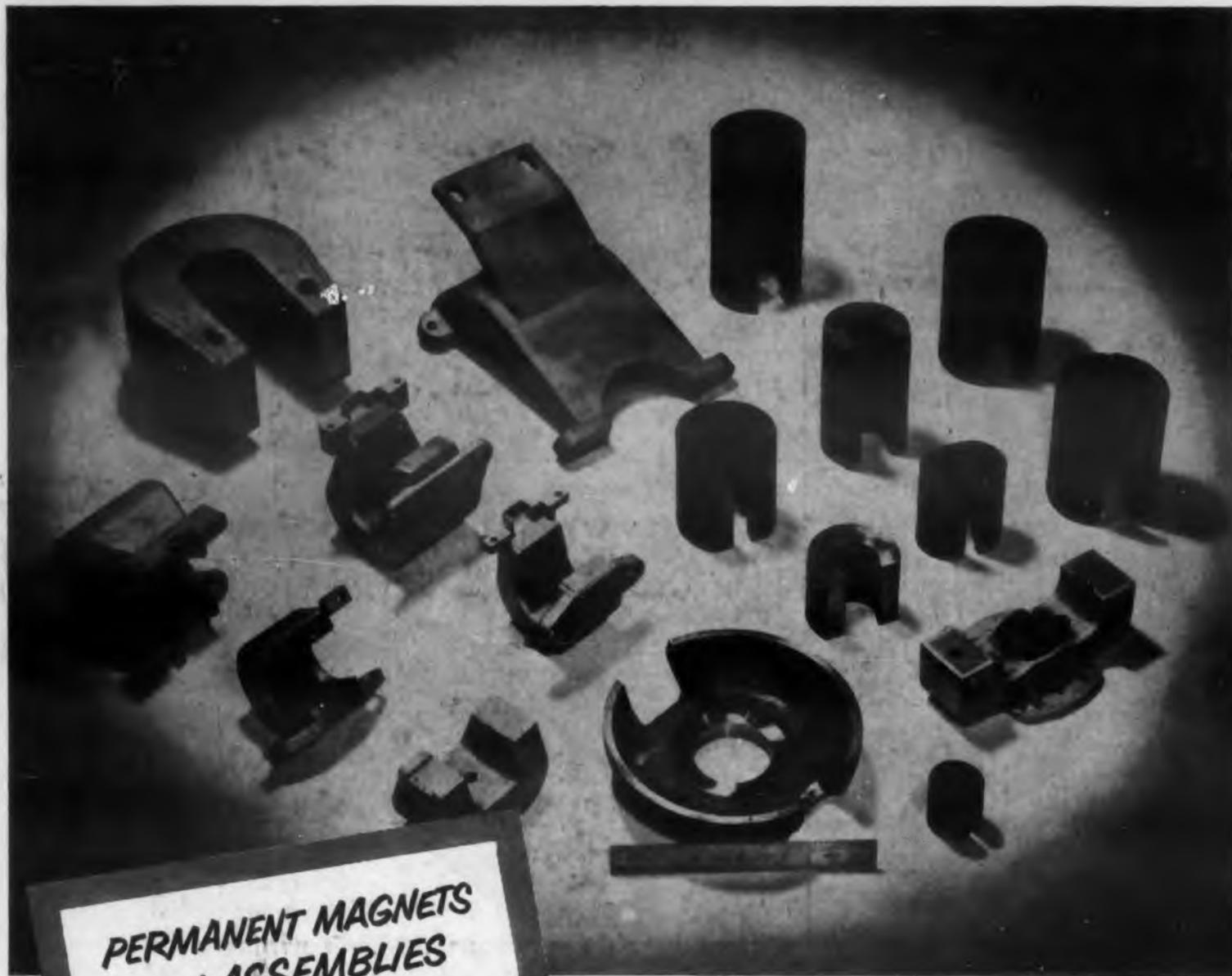
Examples of the advanced thinking that is part of all AMP solderless wiring devices:



*AMP TAPER PINS (1) and TAPER TAB RECEPTACLES (2) designed to save space and weight in electronic circuitry. AMP Pre-Insulated Diamond Grip Terminals (3) eliminate tape and spaghetti and are used extensively by every major aircraft producer. AMPLIVAR Splices (4) speed production for mass produced motor windings, transformers, etc., using enamel, poly-vinyl acetal or similarly coated wire. AMP FASTON Terminals (5) for all kinds of electrical appliances have revolutionized harness sub-assembly methods.*

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32 pages of general data on all Arnold products: cast and sintered Alnico magnets; tape wound cores; Silectron C and E cores; bobbin cores; Mo-Permalloy powder cores; iron powder cores; special magnetic materials, etc.

ADDRESS DEPT. ED-69

The group of magnets illustrated above are indicative of the great scope of Arnold production in this field. We can supply these permanent magnets in any size or shape you may need; in weights ranging from a few ounces to 75 pounds or more; and with die-cast or sand-cast aluminum jackets, Celastic covers, etc., as required. Complete assemblies may be supplied with Permendur, steel or aluminum bases, inserts and keepers as specified—magnetized and stabilized as desired. ● Let us handle your magnetron, traveling wave tube and wave guide permanent magnet requirements, or any other magnetic material specification you may have.

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 Los Angeles: 3450 Wilshire Blvd.      Boston: 200 Berkeley St.

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Commercial tolerance is  $\pm 0.001$  in., and 0.0001 in. can be achieved by grinding (for an additional cost) The parts can be made dense or porous, as desired; the latter is desirable in some cases to permit efficient outgassing.

The Zircon ceramics have a greater thermal shock resistance and are softer than Alumina. The softness allows grinding to a given size at lower cost. Electrical properties are excellent at relatively low operating temperatures.

The steatites are being constantly improved and are relatively low in cost. They were originally chosen for their thermal shock resistance and low-loss properties. As in the Aluminas, the parts can be made in most any shape desired.

#### ► Selection, Forming, & Sealing

Any supplier of whiteware ceramic parts will gladly supply property charts for the choice of a proper type to use for a given application, depending on the electrical and physical requirements.

One of the newer methods of forming parts is called isostatic pressing. The pressure is applied simultaneously in all three directions so the result is a more uniform shrinkage from drying and firing.

The ceramic-to-metal sealing processes have advanced in simplicity in a relatively short period of time. The original and standard process is the 3-step moly-manganese process. It consists of three steps: 1. applying moly-manganese mixture and firing in reducing atmosphere; 2. applying nickel or copper and firing in a reducing atmosphere; and 3. brazing to the metal part. The advantages of this process are a strong bond, good reproducibility and excellent dimensional control. The disadvantages are necessity for three firings, and the fact that firing in hydrogen discolors the ceramics and may impair the electrical properties.

A simpler process for metallizing involves application of titanium hydride to the ceramic parts. The parts are then assembled with a silver-solder wire contact between the parts to be joined. One firing in vacuum or inert atmosphere at a temperature just above the melting point of the solder results in a satisfactory seal.

Another new method uses a titanium cored silver solder in a preformed ring. This ring, like a washer, is placed between the parts in the assembly. One firing in vacuum or inert gas up to 950 C seals the parts together. The primary disadvantage is less dimensional control.

#### ► Special Applications

##### Ceramic Printed Circuits

Printed circuits are relatively new, using silver for the conductor on high dielectric ceramic plates. The printing can be done in various ways, including the silk screen method. Glass now adapts itself for printed circuit base material. Fotoform and Fotoceram are photosensitive glasses that can be machined with photographic precision for ease in the attachment

of parts. The uses for these glasses are barely explored and certainly have many possible applications, when we consider that the holes to be machined can be unlimited in profile and depth.

#### Cermets

Cermets, which are formed by mixtures of metals and metal-oxide powders processed into solids by powder metallurgy methods, find use for cathodes where the metal oxide combinations exhibit thermionic emission. These cermets can be made in almost any desired shape by pressing or extruding and can be held to normal tolerances of 0.005 in. For closer tolerances, grinding methods can be used. The most recent development in shaping is hot pressing. By pressing when the material is fluid, a more homogeneous mass is obtained with resultant higher density and purity.

#### Ferrites

Ferromagnetic ferrites are compounds of various metallic oxides. These are ceramic materials with crystalline structures that have unusual electrical properties such as high volume resistivity and high permeability. To be ferroelectric a material must be inherently polarizable, and the direction of its polarization must be controllable by a relatively weak applied field. Any electrically induced change in polarization will result in a mechanical deformation of the crystal. This property is utilized in devices known as transducers which convert mechanical energy to electrical energy and vice versa.

#### Ultrasonic Resonators

Electrostrictive resonators of barium titanate are used extensively in the ultrasonic field that is developing quite rapidly. Newer applications are in the cleaning of parts and for machining hard materials. The machining can have controlled depth, and hole shapes are unlimited in possibilities.

#### Thermistors

Thermistors are solid-like semiconductors whose electrical resistance varies greatly with temperature. Thermistors have high negative temperature coefficients; i.e., when cold, their resistance is high but drops rapidly as temperature rises. Such characteristics provide a unique and versatile circuit element or control device which can be adapted for many applications including temperature control, flow meters, voltage regulators, switching devices, etc.

#### Varistors

Varistors have the property of a changing resistance when the applied voltage is varied. They have high resistance to negative voltages and extremely low resistances to positive voltages. Some of the materials exhibiting this property are silicon carbide, lead sulfide and selenium, and copper oxide.

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Available only with us in 1/2 oz. in. starting and running torques, and variable frequency units are also available in this new frame size. Units are designed to meet military specifications. Write today for bulletin 1170.

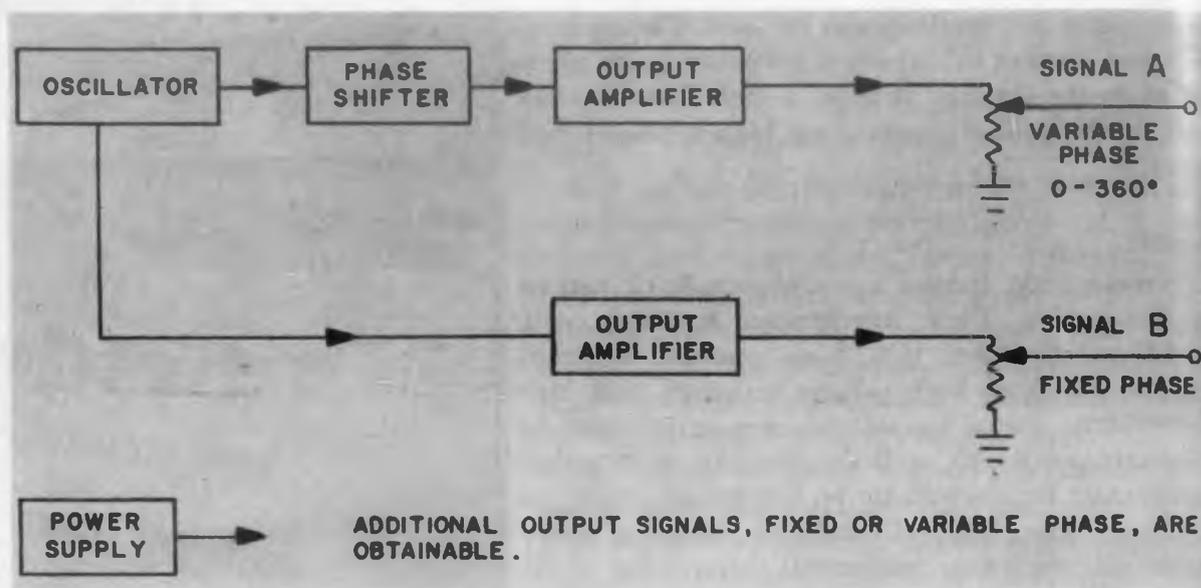
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dedicated to the best in product  
and its service... precision a.c. or  
d.c. motors and mechanical drives



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## Variphase



**F**EATURING an unusually wide frequency range, 0.2 cps to 20 kc, this Variphase Oscillator has two independent signal outputs of the same frequency but with controllable relative phase.

This instrument is manufactured by Dubrow Development Co., 235 Penn St., Burlington, N. J., as Model 445-A and is presently available for commercial use as well as for governmental requirements.

The amplitude of each output signal can be varied independently from 0 to 10 v. A phase-difference dial controls the phase angle between the two signals. This can be varied from 0 to 360 deg, with an accuracy of  $\pm 2$  deg.

Applications include determination of phase shift in an amplifier or network under test, rapid measurements of total harmonic distortion, and time measurements.

For special applications two or three phase-difference dials can be provided, with a corresponding increased number of output signals.

Basic to the Variphase Oscillator is a regulated power supply and stable R-C oscillator.

## Oscillator



The circuit also incorporates a phase inverting amplifier, phase network driving amplifiers, a phase shifting network, cathode followers and output amplifiers. Printed circuits and miniature components are employed which result in a small packaged unit.

For additional information on this product, turn to the Reader's Service Card and circle 391.



WHEN RELIABILITY  
IS A *must!*

**2-1-0**

**Fire!**

### COMPLETE CAPACITOR RELIABILITY

The culmination of all efforts is squeezed into one breathless moment . . . here is where reliability counts.

Astron's Meteor subminiature paper capacitors are advance-designed for reliable operation at temperatures up to  $+125^{\circ}\text{C}$  without derating. Exceptional capacitance stability of Meteor type AQ and TQ over the wide range of  $-65^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  is provided by Astron's newly developed impregnant X-250\*. High insulation resistance, low power factor, unusually low resonance loss, and high test voltage are achieved in a compact, rugged unit.

The Astron Meteor surpasses all applicable military specifications including MIL-C-25A . . . available in a wide range of case styles with extended foil or inserted tab construction . . . hermetically sealed in glass-to-metal closures for complete protection under severe environmental conditions.

Where higher temperature is a factor Astron's Meteor Type XQF is the answer. This metal-cased polyester plastic capacitor has been designed for completely reliable operation up to  $+150^{\circ}\text{C}$  without derating. Physically and electrically it surpasses government and commercial requirements.



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Export Division: Rocke International Corp., 13 East 40th St., N. Y., N. Y.  
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\*Trademark

CIRCLE 32 ON READER-SERVICE CARD FOR MORE INFORMATION

- **Whisker Loader:** allows accurate measurement of contact area between pointed .005" diameter wire and semiconductor surface. IBM Bulletin No. 300.
- **Thimbleful of Liquid Memory:** using the nuclei of hydrogen to store information. IBM Bulletin No. 301.

For bulletins, write to Dept. ED-9, IBM, 590 Madison Ave., New York 22, N. Y.

#### Whisker Loader

Transistors are a "natural" for computers because of their small size, long life, and lower power needs than vacuum tubes. While most transistors used today are of the junction type, some applications require the point-contact type. In this type, the desired trace element is introduced into the germanium "heart" by



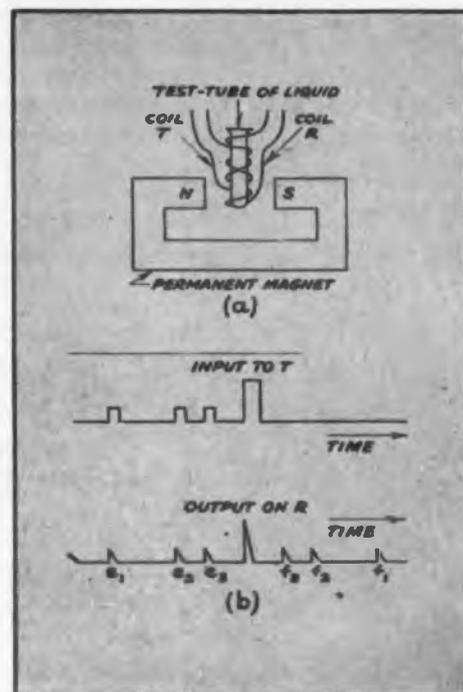
passing a large pulse of current through the pointed wire—which contains the desired trace element and which is in contact with the germanium. The result: heat causes the element to penetrate—or diffuse into the germanium. An important problem in the development of a manufacturing process for this type of transistor was to determine—one at a time—the influence on the diffusion process of each of the various factors involved. Jim Hanson, of our Poughkeepsie Research Laboratory, tackled this problem and came up with some of the answers by using what he calls the Whisker Loader. This precision instrument which he developed makes it possible to place the point of a five one-thousandths inch diameter wire upon the germanium surface; momentarily press the point against the surface with an accurately determined force of several grams; remove the wire and measure and inspect the area of contact between the wire and the germanium

with a microscope (as small as one hundred-millionth of a square inch); and then replace the wire on the germanium, in the same position it first occupied, for electrical pulse forming. Our knowledge and understanding of pulse-forming techniques have been greatly increased by the use of this instrument.

A full report that clearly details test procedures, test results and other pertinent data is available in IBM Bulletin No. 300. Write for your copy.

#### Liquid Memory

Put a small amount of liquid such as glycerine in a d-c magnetic field, apply radio frequency pulses, and one can obtain radio frequency "echoes" of the applied pulses! This is the essence of the spin-echo effect which has been used by IBM scientists to store information in liquids containing hydrogen nuclei. By proper combinations of r-f pulses, hundreds of echoes in "mirror order" or in "normal order" can be obtained. Refer-



ring to schematic below, when a liquid containing hydrogen—such as water or glycerine—is put into the test tube and pulses of r-f current are applied to coil T, pulses will be produced across the terminals of coil R as shown. The pulses  $e_1, e_2,$  and  $e_3$  are found only if pulses  $f_1, f_2,$  and  $f_3$  have been applied and hence are called "echoes."

The effect may be understood in terms of the magnetic moments and angular momenta or spins of the hydrogen nuclei. In the d-c magnetic field, the nuclear moments are aligned so that the net moment throughout the sample is parallel to the field. A weak r-f pulse tilts the net moment away from the d-c field, about which it then precesses. But, due to inhomogeneities in the field, moments in different parts of the sample precess at slightly different rates . . . get out of phase with one another, and hence cannot be detected. The strong r-f pulse rotates all of the moments so that those which were farthest ahead in phase become farthest behind, and conversely. Subsequent precession brings the moments back into phase, giving rise to the echo signal.

A research group at the IBM Watson Laboratory in New York City, headed by Robert M. Walker, has investigated this effect and succeeded in storing a thousand "bits" of information in a thimbleful of liquid. Some day this form of memory may be an important component of a computing machine.

This method of storage based upon the principles of free nuclear induction is more fully described in IBM Bulletin No. 301.

To learn more about career opportunities available at IBM, write, describing your background, to: W. M. Hoyt, IBM, Room 909, 590 Madison Avenue, New York 22, N. Y.



**H**IGH power in miniature size and single hole chassis mounting make this new wire wound resistor significantly interesting. More rapid heat dissipation is afforded by a finned surface on the die cast aluminum housing, together with the location of the resistor hot spot in close proximity with the chassis.

Manufactured by Dale Products, Inc., Box 136, Columbus, Nebr., DALOHM PH-25 resistors are available in values from 0.1 to 15,000 ohms, and with tolerances from 0.5 to 5 per cent. Power rating is 25 w at 25 C ambient, derated to 0 w at 265 C when mounted on a 12 x 12 x 0.056 in. panel. The maximum safe operating temperature is 265 C. Temperature coefficient of the element wire is 0.00002/deg C. Voltage breakdown is 1000 v dc rated, as determined by hi-pot test. Insulation resistance is 20,000 megohms minimum at 25 C ambient temperature.

Fully protected for shock and vibration, and weighing only 15 gm, these resistors are silicone sealed against environmental effects of moisture and salt spray. Both lug-type terminal leads protrude from the resistor on the same side of the chassis. The resistor meets applicable photographs of MIL-R-18546-A (Ships) and MIL-R-26-B.

For further information on these new resistors turn to Reader's Service Card and circle 392.

Laboratories at Endicott, Owego, Poughkeepsie and Kingston, N. Y., and San Jose, Calif.

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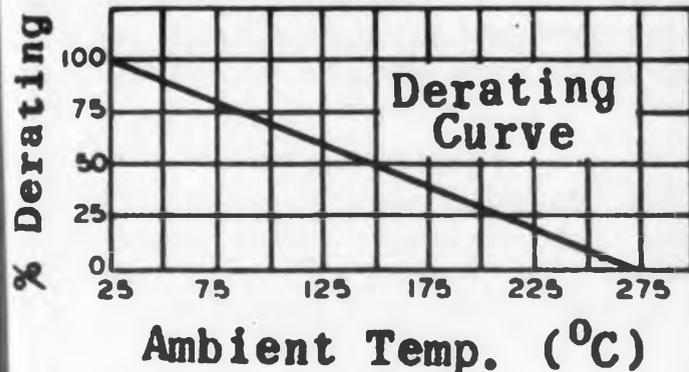
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## Miniature 25-Watt Power Resistor

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# Probes for Multimeters

*for h-f test leakage*

**Robert G. Middleton**

Consultant, Futuramic Co.

**V**OLT-OHM-MILLIAMMETERS are the most popular type of electrical testers in use at present. Many more VOMs have been sold than any other test instrument. In spite of its widespread usage, auxiliary devices and accessories to increase the fields of usefulness of the VOM have been somewhat neglected in the past. Today, however, such accessories have made an appearance, and are rapidly gaining general attention. Several probe accessories are discussed in this article.

## Signal Tracing Probe

The signal-tracing probe illustrated in Fig. 1 is typical of the new accessory devices designed for use with any VOM. The probe is basically a traveling detector, which rectifies and filters rf, if, af, and lf

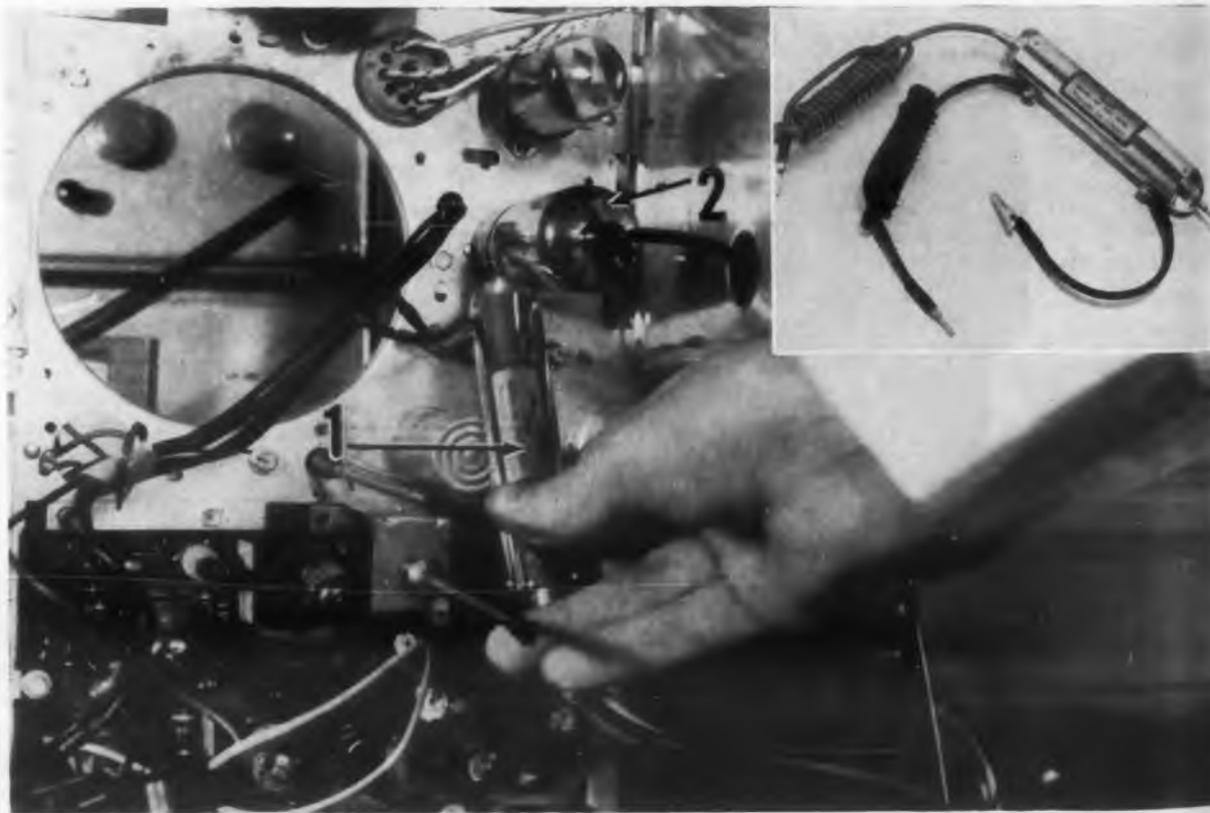


Fig. 1. Operator tests signal level in horizontal-output stage by holding probe tip against glass wall of tube. The probe (inset) converts any 20,000 ohms-per volt meter into a signal tracer.

voltages for indication on the dc volts scale of the VOM. The probe is plugged into the meter in place of the conventional test leads, and finds numerous applications in radio, TV, and industrial electronic work. When applied in TV receiver circuits, the probe permits the user to isolate trouble in weak or dead stages. Tests can be made in the rf tuner, video if amplifier, picture-detector, video-frequency amplifier, audio if, audio-frequency, sync and sweep circuits.

Perhaps one of the most interesting features of the new probe is the fact that tests of high-level stages do not require electrical contact with the circuit, as illustrated in Fig. 2. The operator can test the horizontal-output stage for example, by merely holding the probe tip against the glass wall of the tube, and capacitive transfer of pulse voltage provides ample meter indication. A typical indication of 1 v is obtained in this test for a normally operating stage.

### Increased Resistance Range

Another interesting new accessory probe is shown in Fig. 3; here a leakage test is being made on a fixed capacitor by means of a high-ohms probe. The probe provides an additional high-resistance range on the VOM, by converting the Rx10,000 range to an Rx100,000 range. In making the resistance scale 10 times more sensitive, the ohmmeter indicates resistance values up to 200 megohms when the probe is utilized; without the high-ohms probe, the ohmmeter can indicate resistance values only up to 20 megohms.

Operation of the probe is made possible by use of three transistor batteries and a suitable multiplier resistor. Not only can resistance values 10 times higher than usual be measured, but the high-ohms probe also increases the accuracy of indication of resistance values in the range in the interval from 1 to 20 megohms; the higher accuracy is obtained by indication of these values on the expanded portion of the ohmmeter scale, where the observational error is negligible.

Because the probe is battery-powered, the batteries eventually require replacement after extended service. This point is reached when the operator can no longer zero-set the pointer on the meter scale by means of the zero-adjust control on the VOM. However, extended life is realized from the batteries, since the current drain is very low. A maximum current of 50  $\mu$ a is required during tests.



Fig. 2 High-ohms probe measures leakage resistance up to 200 megohms in capacitors.



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Hundreds of aircraft electrical circuits, adding up to thousands of feet of wire, are tested in minutes by an analyzer connected by Hubbell Interlock Plugs. Only a locking contact, such as Interlock provides, can assure the uninterrupted flow of current and accuracy required for this vital circuit testing . . . and only plugs that disconnect so quickly and easily, when circuit changes are necessary, would be feasible in a mass wiring set-up such as this, used by Trans World Airlines, Inc. Hubbell Interlock Plugs and Connectors play an important part in this, as in a wide variety of applications that require absolute accuracy of readings. They are used by some of the world's largest manufacturers of electrical and electronic equipment.

\*Circuit Analyzer manufactured by DIT-MCO, Inc., Electronic Division, Kansas City, Mo.

For Complete Information On  
Other Interlock Products, Write



**HUBBELL, INC.**

Interlock Electronic Connector Dept., Bridgeport 2, Conn.

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**LINCOLN LABORATORY**

**50kw UHF SCATTER**

**INSTALLATION USES**

**EIMAC KLYSTRONS**

Lincoln Laboratory uses Eimac klystrons again in its 50kw experimental tropospheric scatter installation at Round Hill. As a pioneer in this revolutionary new communication concept, Lincoln Laboratory, of the Massachusetts Institute of Technology, has been instrumental in developments leading to reliable military and commercial scatter networks.

Engineers responsible for advancing the art of tropospheric scatter set forth exacting requirements. Eimac klystrons have met these requirements through each stage of the evolution of high power.

*Fourth in a series on the extensive scatter application of Eimac klystrons.*

**Eimac**

THE POWER  
FOR FORWARD-SCATTER



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SAN BRUNO, CALIFORNIA

The World's Largest Manufacturer of Transmitting Tubes



**T**HREADED fasteners can be vibration-proofed with a new liquid sealant. Heavy vibration does not loosen the locking action but simple torque tools easily separate the threaded hardware.

Manufactured by American Sealants Co., Trinity College P.O. Box 260, Hartford 6, Conn., Loctite is a clear, low viscosity liquid with the property of hardening automatically when confined between the surfaces of closely fitting metal parts. It forms a strong seal which is heat and oil resistant.

Loctite remains liquid if kept in its original container. It remains liquid as a film on the metal parts prior to final assembly. A penetrating liquid, it readily wicks into the joint between a nut and bolt. Maximum strength on hardening occurs in about 24 hours following the assembly operation.

Metal threaded fasteners can be treated in large lots by tumbling or can be individually coated with a felt or cotton swab, hand-dipped into a container of the fluid or drop dispensed from a bottle. One 10 cc bottle treats 1,000 #10 machine screws.

Loctite is found to work well with all metals and can be used as a substitute for lockwashers and pins. The sealant is not recommended for organic and lacquer type finishes. Loctite treated assemblies may be painted after degreasing.

Hardened sealant can be removed with hot caustic soda. Excess sealant can be removed with

CIRCLE 37 ON READER-SERVICE CARD FOR MORE INFORMATION

# Liquid Lock Washer

an absorbent towel dampened with carbon tetrachloride.

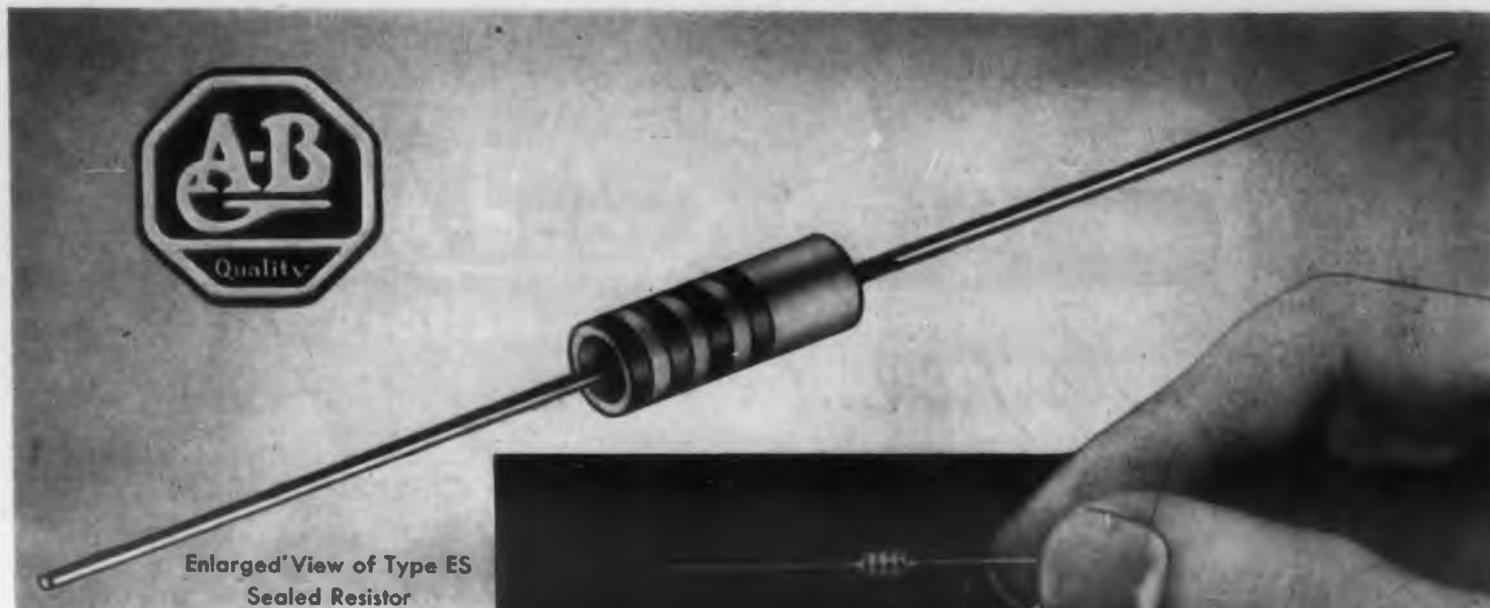
In the case of certain finishes, cadmium and zinc plating for example, the parts must be dipped in a degreasing solvent with 2% of Locquic activator and allowed to dry before applying Loctite and joining.

Loctite sealant is cheaper to use than all sizes of lock nuts and many sizes of sems. Usage determines which of several types of Loctite is required for a given application.

For further information on this product, turn to the Reader's Service Card and circle 393.



Torque comparisons of loctite, locknut, and spring lockwasher



*It  
cannot be  
true —  
But,*



*Here is what the new A-B hermetically sealed composition resistors will do!*

#### Unaffected by humidity or moisture

Humidity and moisture have been nuisance factors to all composition resistors. The type of hermetic sealing built into the new A-B Type TS and Type ES resistors entirely eliminates this possible objection.

#### Higher temperature rating

Special techniques have made it practical to increase the operating temperature beyond the rating heretofore considered "safe" with composition resistors.

(Type TS: .125 Watt... 70°C, 0-derating at 110°C)  
(Type ES: 1 Watt...70°C, .5 Watt...120°C, 0-derating at 165°C)

#### 2% and 5% tolerances

The amazing stability incorporated in Allen-Bradley composition resistors has made a 2% tolerance a realistic and usable circuit design possibility.

#### Extremely low noise level

All microphonic noise, occasionally encountered in composition resistors due to shock and vibration, has been eliminated.

#### From 10 ohms to 500,000 megohms

Although normally supplied in the standard ranges from 10 ohms to 22 megohms, these resistors are also available for special applications in extremely high resistance values, the

limits being determined largely by the capability of the measuring equipment.

#### Catastrophic failure impossible

For the first time a resistor is now available having characteristics approaching wire-wound "precision," plus the established reliability of the A-B hot-molded composition units, assuring complete freedom from catastrophic failure.

#### Designed for manhandling

The hot-molded Allen-Bradley composition resistor in its ceramic enclosure and high temperature end seals results in an unusually rugged construction, possessing uniformity of size and configuration, making these resistors ideal for mechanical handling.

#### Allen-Bradley quality and uniformity

Experience gained from the production of hundreds of millions of hot-molded resistors, combined with typical Allen-Bradley quality control, has produced a resistor unique in performance and especially adaptable for the always increasing critical applications of military and computer circuitry. You will want to become better acquainted with this new development in resistors! Representative values can be furnished for test.

**ALLEN-BRADLEY**  
RADIO & TELEVISION COMPONENTS  
QUALITY

Allen-Bradley Co.  
1344 S. Second St., Milwaukee 4, Wis.

Please send me technical data on the A-B hermetically sealed resistors.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

CIRCLE 38 ON READER-SERVICE CARD FOR MORE INFORMATION

GOOD-ALL

**Good-ALL**  
capacitors

*It's New...!*

**A MYLAR\* dielectric capacitor  
MOLDED IN EPOXY**

The superior moisture resistance of EPOXY gives far better humidity protection than commonly used molding materials. High dielectric strength is also an attractive property of this tough, dense plastic.

Exclusive Good-All molding technique eliminates all possibility of deforming or otherwise damaging windings during the molding process. Uniform wall thickness is carefully maintained.

**600-UE**

Leads are securely bonded in the EPOXY molding compound. This extremely tight bond prevents moisture from entering the capacitor at this point.



The dark maroon capacitor body is exceptionally durable as well as attractive.

Since overall dimensions are held within close tolerances, this capacitor type is ideal for automatic machine insertion.



**600-UPE**

The same quality features illustrated in the cut-away drawing are available in *Pin Types* for use in upright mounting.

**GOOD-ALL TYPE 600**

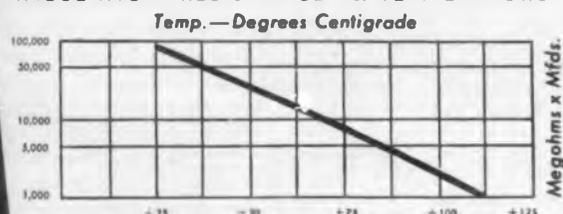
The outstanding combination of a space-saving Mylar winding sealed in moisture resistant EPOXY provides you with premium performance in a rugged compact design. This new capacitor incorporates these valuable properties of Mylar dielectric . . . HIGH IR, STABILITY WITH LIFE and LOW POWER FACTOR. Good-All Types 600-UE and 600-UPE (for upright mounting) are priced to encourage widespread use in both consumer products and industrial equipment.

\*DU PONT'S TRADEMARK FOR POLYESTER FILM

**SPECIFICATIONS**

**Insulation Resistance** . . . Greater than 75,000 Megohm-Mfd. at 25°C (See curve below for higher temperatures)  
**Power Factor** . . . . . Less than 0.5% from +25°C to +85°C  
**Temperature Range** . . . May be operated at rated voltage from -65°C to +85°C and to +125°C with derating  
**Humidity Resistance** . . . . . Far surpasses requirements of RETMA Spec. REC-118-A  
**Voltage Range** . . . . . 100, 200, 400 and 600 Volts D.C.

INSULATION RESISTANCE vs. TEMPERATURE



DIMENSIONS OF TYPE 600-UE, 100 VOLTS D.C.

CAP.	SIZE	CAP.	SIZE
.015	.312 x 1 <sup>3</sup> / <sub>16</sub>	.15	.500 x 1 <sup>3</sup> / <sub>16</sub>
.047	.375 x 1 <sup>1</sup> / <sub>16</sub>	.22	.500 x 1 <sup>9</sup> / <sub>16</sub>
.1	.438 x 1 <sup>3</sup> / <sub>16</sub>	.47	.562 x 1 <sup>1</sup> / <sub>16</sub>

Paper Dielectric capacitors are also available in molded Epoxy Types

Our engineers are ready to work with you on special applications. Write or wire for specifications and quotations.



**GOOD-ALL ELECTRIC MFG. CO.** • OGALLALA, NEBRASKA

A leading manufacturer of Tubular and Ceramic Disc Capacitors

CIRCLE 39 ON READER-SERVICE CARD FOR MORE INFORMATION

**Multi-Media R**

**T**HIS 6-channel recording oscillograph offers, for the first time in one unit, the choice of three different media for recording. It permits the use of ink or electric-sensitive paper for curvilinear recording, or heat sensitive paper for rectilinear recording.

Manufactured by Offner Electronics, Inc., 5328 N. Kedzie Ave., Chicago 25, Ill., the "Dynograph" makes possible the rapid substitution of one recording medium for another. The unit is equipped with inkwells and with stylus heating facilities. Styli are interchanged when shifting from one medium to another and can be lifted from their cradles without the use of tools. The only part of the paper drive mechanism which must be interchanged is the pressure roll against the paper feed roll. For electric-sensitive recording the assembly is used



Dynograph with electric styli.  
Heated Styli are similarly installed.

# ia Recorder

ph of  
it, the  
record-  
electric-  
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record-

much the same as with the ink recording; the styli, however, have stainless steel wires which are connected to a voltage source for marking the paper.

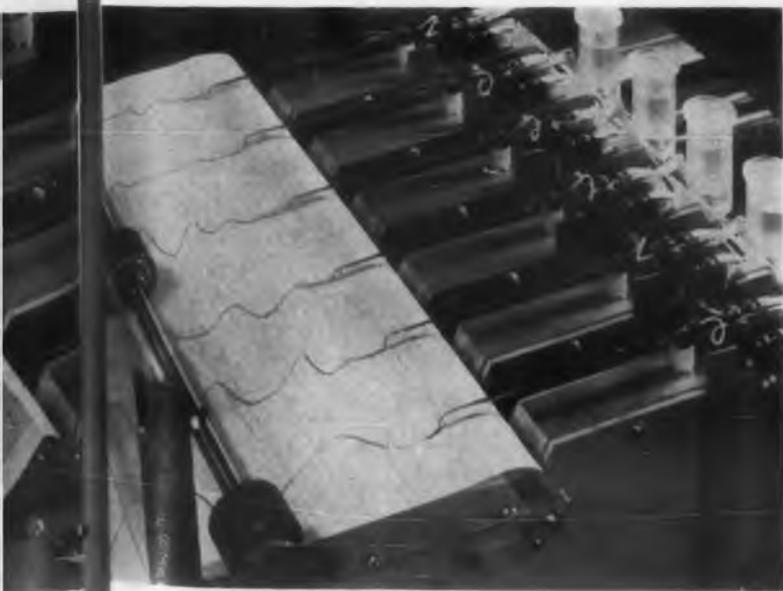
ronics,  
5, Ill.,  
rapid  
um for  
kwell's  
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The "Dynograph" employs a chopper amplifier which can be used for all applications. It is free of drift, yet has a sensitivity of  $15 \mu\text{v}/\text{mm}$  of pen deflection. This permits strain gages to be excited with dc and avoids the complexity of carrier systems and their necessary reactance balance. The same amplifier can be used equally well with thermocouples for temperature recording, for all types of ac and dc recording, and with reluctance gages. In the latter application, the chopper converts ac to dc before application to the gage.

For additional information on this product, fill out the Reader's Service Card and circle 394.

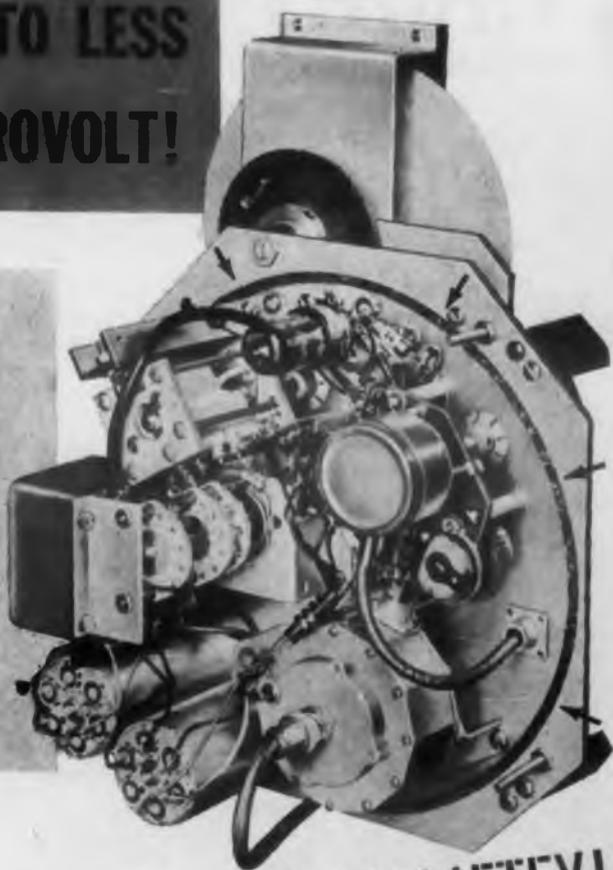


Rack-mounted Dynograph assembly. The amplifiers are at the left, the input couplers to the right. The stylus control panel is below, and just above the slide-out recorder.



Dynograph with inking styli.

**RF LEAKAGE  
CONTROLLED TO LESS  
THAN  $\frac{1}{10}$  MICROVOLT!**



**ANOTHER PROBLEM SOLVED BY METEX!**

This Type 240-A Sweep Signal Generator built by Boonton Radio Corp., Boonton, N. J., is designed to operate at controlled output levels down to  $\frac{1}{10}$  microvolt. To prevent RF leakage between the oscillator chassis and oscillator cover, Boonton engineers specified a METEX RF gasket at this critical joint. This METEX RF gasket, knitted of monel wire, prevents RF leakage so successfully that peak performance is obtained at minimum output levels where leakage was previously experienced.

METEX RF Shielding, knitted of monel, aluminum or silver plated brass wire, combines maximum *conductivity* for efficient performance with inherent *resiliency* that assures continuous line contact between imperfect mating surfaces. Interlocked loops, knitted of continuous wire strands, assure maximum *cohesion*.

If you have a problem involving RF shielding in electronics or related equipment, write METEX, today!

**ELECTRONICS DIVISION  
METAL TEXTILE CORPORATION**

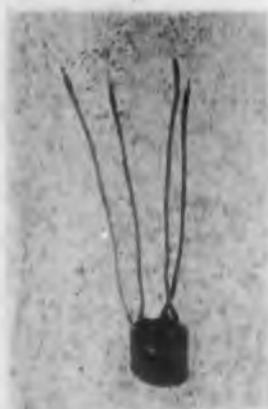
ROSELLE, NEW JERSEY

CIRCLE 40 ON READER-SERVICE CARD FOR MORE INFORMATION

# New Products

Products marked with a star are those being exhibited for the first time at the Radio Engineering Show, and include the company's booth number.

## Miniature Transformers For Transistor Circuits



A series of transformers is offered by this firm for transistor circuit applications. These units feature very small size, high efficiency nickel alloy cores, bobbin wound windings, and flexible coded leads. They have open type mountings.

Two interstage, one output, and one input transformer are available in 1 mw ratings, and another input transformer in a rating of 20 mw. Weight of the smaller units is 0.08 oz, and size is 11/32 x 3/8 x 3/8 in. The 20 mw unit weighs 1 oz and measures 3/4 x 5/8 x 5/8 in.

Merit Coil Products Co., Inc., Dept. ED, 4427 N. Clark St., Chicago, Ill.

CIRCLE 41 ON READER-SERVICE CARD FOR MORE INFORMATION

## Load Cells

Feature  $\pm 0.10\%$  Linearity



These SR-4 universal-type load cells of 50, 100, and 200 lb capacity have been reduced substantially in size and designed with linearity (within  $\pm 0.10\%$ ) improved 100% over previous models.

The principle of the bonded resistance wire strain gage is utilized in the cells. They measure 3-1/4 in. in height x 3-1/2 in. diam, permitting more compact SR-4 electronic weighing and control systems.

Electronics and Instrumentation Div., Baldwin Lima-Hamilton Corp., Dept. ED, 806 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 42 ON READER-SERVICE CARD FOR MORE INFORMATION

## Noise Eraser For Magnetic Tape



The N-HF "Noiseraser" is one of a series of bulk magnetic tape degaussers. It contains a powerful magnetic circuit which removes recorded and undesirable signals from entire reels of tape in a matter of seconds, 4-6 db below standard erase head levels of demagnetization. It is recommended for 1/4 in. magnetic tape on reels up to 10-1/2 in. diam, and it operates from the ordinary ac convenience outlet. Size is 7-3/4 x 4-3/4 x 3-1/4 in. deep. Weight is 8 lb.

Librascope, Inc., Burbank Div., Dept. ED, 133 E. Santa Anita St., Burbank, Calif.

CIRCLE 43 ON READER-SERVICE CARD FOR MORE INFORMATION

## Low Inertia Servo Motor

A Size 15 Unit



High reliability is featured in this size 15 servo motor. Class H and Class B materials are utilized to allow safe operation over temperatures from  $-60$  to  $+120$  C.

Input is 115 v, 400 cps. No load speed is 5000 rpm, and stall torque is

1.5 in.-oz. Bearings are stainless steel with special high temperature lubricants.

The motor is offered in two models: M-110 has a 13 tooth 120 pitch pinion, and M-111 has a 15 tooth 96 pitch pinion.

Basler Electronics, Inc., Dept. ED, Highland, Ill.

CIRCLE 44 ON READER-SERVICE CARD FOR MORE INFORMATION

## T/C Reference Junction

Withstands Missile Environments



This miniature, multichannel "hot" thermocouple reference junction operates from ac or dc and is stable to 1.5 F. A maintenance-free unit, it replaces ice bottles and temperature compensators. The unit is

rugged enough for missile use and can be provided with any type of junction required, such as iron-constantan, cromel-alumel, copper constantan, etc.

Arnoux Corp., Dept. ED-7, Box 34628, Los Angeles, Calif.

CIRCLE 45 ON READER-SERVICE CARD FOR MORE INFORMATION

## Subminiature Filters

For IF Amplifiers



This line of subminiature filters is designed for IF amplifiers for printed circuit use. The units are temperature compensated to 0.15% from  $-55$  to  $+85$  C. Size

of the filters is 13/16 x 2-1/2 x 2 in. high.

Units available for operation at 1.3 mc cover a 100 kc band width at 6 db, and 200 kc at 60 db. Units available for operation at 12.5 mc cover a 300 kc band width at 6 db, and 1100 kc at 60 db.

Burnell & Co., Inc., Dept. ED, 45 Warburton Ave., Yonkers 2, N.Y.

CIRCLE 46 ON READER-SERVICE CARD FOR MORE INFORMATION

## Precision Needle Files

### Swiss Made

High grade carbon steel files, 5-1/2 in. long, are offered in seven individual shapes: round, halfround, flat, square, oval, triangular, and knife edge, and all have No. O cutting surface. Separated for easy selection, these files are packaged in an attractive, sturdy plastic tube.

Centralab, Dept. ED., 900 E. Keefe Ave., Milwaukee 1, Wis.

CIRCLE 47 ON READER-SERVICE CARD

## New Moving Coil Pickup

### Diamond Stylus

"Micradjust" Diamond Stylus Pickup, 225 Series, based on the high compliance moving coil principle, is flat to 20,000 cps with smoothly decreasing response beyond. Its low impedance (200 ohms) design provides average output of 5 mv which drives all modern amplifiers without requiring a step-up transformer.

Improvements in the mechanical assembly, which eliminate attraction for steel turntables, allow use of the Fairchild 225 with any changer. The low impedance moving coil permits up to 50 foot separation of phonograph from the preamplifier with no loss of high frequencies. Size, weight, and mounting dimensions are RETMA standards and fit all transcription arms and changers.

Fairchild Recording Equipment Co., Dept. ED, Whitestone 57, New York.

CIRCLE 48 ON READER-SERVICE CARD

## Subminiature Tubular Capacitors

### Mineral Oil Impregnated

Impregnated with mineral oil, a subminiature metal-clad tubular capacitor is now being produced. To operate at 85 C, the unit is designed for "work-horse" applications in military electronic circuits.

Ratings of the units are 0.001 to 1.0  $\mu$ f, at 100 to 600 v dc. Available tolerances are 5 per cent, 10 per cent and 20 per cent.

General Electric, Schenectady, N. Y.

CIRCLE 49 ON READER-SERVICE CARD



case history No. 5 of  
JFD Piston Capacitors  
at work



# PISTON CAPACITORS AT WORK

You're a jet fighter pilot streaking home to your carrier 200 miles distant . . . somewhere in the dead of night . . . above a pea-soup fog. No margin for error here . . . minutes, yards mean the difference between success and failure. Yet you're guided unerringly every second of the flight. Safely . . . swiftly you let down to home base—thanks to TACAN (Tactical Air Navigation).

Federal Telecommunication Laboratories specified the Model VC11 JFD Variable Trimmer Piston Capacitors in its TACAN development program for the U. S. Navy and U. S. Air Force. Used in the Ferris discriminator circuit of the IF amplifier, the VC11 is used in adjusting critical band pass frequencies to prevent adjacent channel interference. Compactness . . . stability . . . shock-resistance . . . imperviousness to temperature variations . . . — these are a few of the reasons why today Federal Telephone and Radio Co., Hoffman Laboratories, Inc., and Stromberg-Carlson Co. (A Division of General Dynamics Corporation), are building JFD VC11 Capacitors into TACAN equipment.

The VC11 is one of 50 miniature and subminiature trimmer capacitors upgrading performance in today's most sensitive printed and conventional electronic circuits. Wouldn't you like to see how they can help you on *your* project?



ACTUAL SIZE

### MODEL VC11

Approx. zero temperature coefficient,  
1 to 10 mmf.,  
fused quartz dielectric,  
invar rotor



JFD ELECTRONICS CORPORATION

1462-62 STREET BROOKLYN, N. Y.

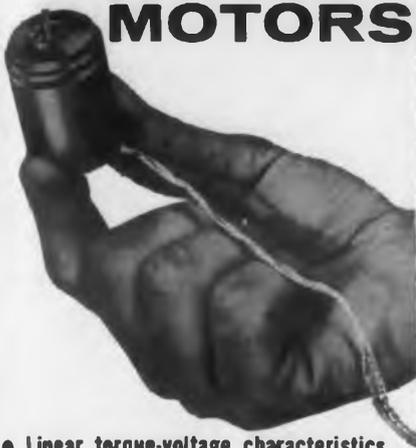
CIRCLE 50 ON READER-SERVICE CARD FOR MORE INFORMATION

Go Forward with JFD Engineering!



# Now on the shelf!

## PRECISION SERVO MOTORS



- Linear torque-voltage characteristics
- Linear torque-speed characteristics
- Withstand continuous stalling
- High torque efficiency

**Guaranteed  
shipment  
within 10 days  
for these units:**

(Subject to prior sale)

CIRCLE THE MOTORS FOR WHICH YOU ARE INTERESTED IN HAVING PRICES AND DATA	VOLTAGE			
	WATTS	CYCLES	SUPPLY	CONTROL
1/2	400	115	180	
1 1/2	60	115	180	
2 1/2	60	115	115	
5	60	115	115	
5	400	115	115	
5	60	115	250/250	
5*	60	115	250/250	
5	400	115	250/250	
5*	400	115	250/250	
10	60	115	115	
10	400	115	115	
10	60	115	250/250	
10	400	115	250/250	
10**	400	115	57.5/57.5	

\*Have double shaft extension (all others are single).  
\*\*Designed for mag-amp systems.

Mail this coupon to:

**FORD INSTRUMENT COMPANY**  
DIVISION OF SPERRY RAND CORPORATION  
31-10 Thomson Ave., Long Island City 1, N. Y.

Attention: Component Sales ED

OR, call or wire R. Banka for prices  
(STillwell 4-9000, Ext. 513).

Please send me prices on the servo motors I have circled above.

Please send me fully illustrated data bulletin giving specifications and performance information.



Name \_\_\_\_\_  
Position \_\_\_\_\_  
Company \_\_\_\_\_  
Street \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

CIRCLE 55 ON READER-SERVICE CARD

## Stainless Steel Nameplates

Last Lifetime In Extreme Conditions



New 0.002 in. stainless steel Foilcals that are non-corrosive, non-fading, and have extremely high abrasion resistance are being manufactured. These new Foilcals are especially made to withstand

excessive abrasion or extreme weather conditions.

This new product comes in two finishes, dull and electro-polished bright, and lends itself to applications on products where high style is desired. A wide range of color selection is available for etched sunken or etched raised letters.

Various types of adhesives can be furnished, eliminating the use of metal fasteners. Foilcals can be applied to curved or wrinkled surfaces.

Miller Dial & Name Plate Co., Dept. ED, 4400 No. Temple City Blvd., El Monte, Calif.

CIRCLE 56 ON READER-SERVICE CARD FOR MORE INFORMATION

## Expanding Mandrels

Straight Jaws



New patented count-centric expanding mandrels with straight jaws provide an extra long bearing surface over a wide bore range, longer than any other standard expanding mandrel, and permit a greater bore expansion without change of jaws or sleeve.

Permanent jaws maintain built-in precision of Le Counts' count-centric mandrels to 0.0005 in. T.I.R. for type "B" and to 0.0002 in. T.I.R. with

Type "SB". Permanent jaws maintain built in precision and permit heavy cuts without chattering. Only 14 precision tools provide for every bore size from 3/8 to 3 1/4 in.

A miniature duplicate of the "Count-Centric" straight jaw mandrels is the type "MM" and "SM" Micro-Mite expanding mandrel. This smaller version is designed to enable precision instruments and electronic manufacturers to achieve miniaturization without the cost of special holding devices.

Only six standard tools provide every arbor size from 1/4 to 3/8 in.

The Le Count Tool Works, Inc., Dept. ED, 390 Capitol Ave., Hartford, Conn.

CIRCLE 57 ON READER-SERVICE CARD FOR MORE INFORMATION



THERMAL CONDITIONING OF ROCKETS AND GUIDED MISSILES



HEATING OPTICAL, ELECTRONIC, OR HYDRAULIC AIRBORNE EQUIPMENT

## WHERE CAN YOU USE G-E SPECIALTY HEATING EQUIPMENT?

Whenever your equipment requires thermal conditioning, General Electric specialty heating equipment can help.

G.E. has had extensive design and manufacturing experience in providing controlled heating for a wide variety of applications. These applications range from giant guided missile blankets to tiny one-inch-long accelerometer heaters. Problems of intricate shape, large or small size, unusual environmental conditions, and amount of heat required have all been solved.

**LET US ANALYSE YOUR HEATING PROBLEM;** a General Electric specialty heating expert is available and a prompt answer is assured.

FOR MORE INFORMATION contact your General Electric Aviation and Defense Industries Sales Office or send coupon.

General Electric Company  
Section L 220-10A, Schenectady 5, N. Y.

Please send me new bulletin GEA-6285,  
G-E Specialty Heating Equipment.

- for immediate project  
 for reference only

Name \_\_\_\_\_

Position \_\_\_\_\_

Company \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

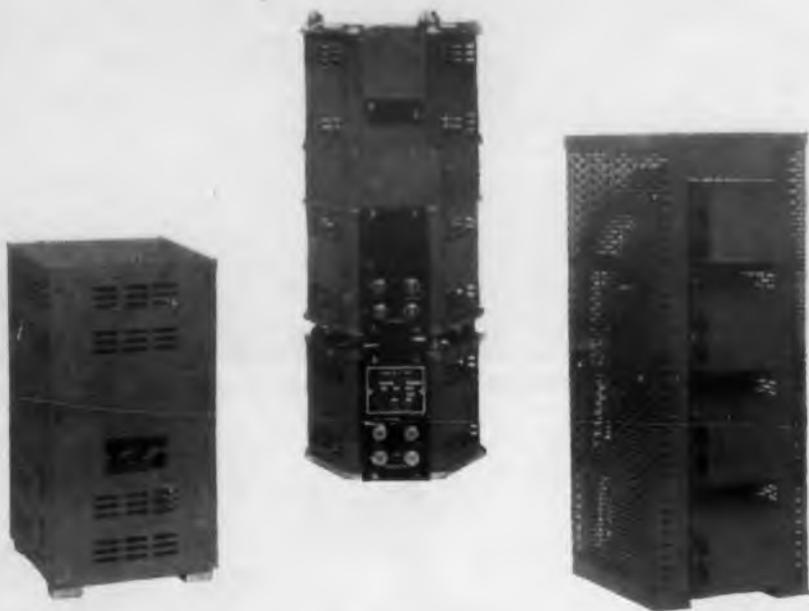
*Progress Is Our Most Important Product*

**GENERAL  ELECTRIC**

CIRCLE 58 ON READER-SERVICE CARD FOR MORE INFORMATION

## new *Adjust-A-Volts*

### Motor-driven variable transformers for remote control operation



You'll like the design and performance of these compact, durably constructed motor-driven units for commercial and military applications where remote control of variable voltage by push button or switch is desired.

They have all the features of manually operated Adjust-A-Volt variable transformers plus a standard 115 V, 60 cycle motor, all enclosed in a well-ventilated and protective grey wrinkle finished case.

Choose from twenty-two basic models—single or up to 6 ganged assemblies with a load rating range from .35 to 28KVA—115 V or 230 V input.

Full range travel speeds of 6, 13, 26, or 45 seconds available to suit your need. All units are equipped with clockwise and counter-clockwise limit switches.

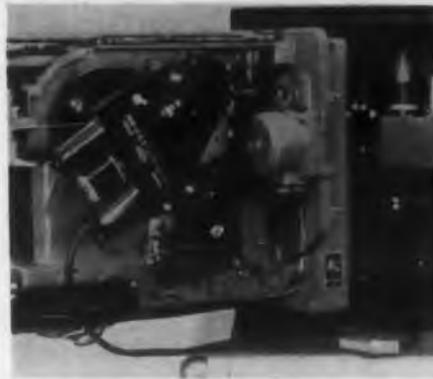


Send for your copy of the new 22 page Adjust-A-Volt catalog A56 which describes and illustrates the entire Adjust-A-Volt line and features dimensional drawings and a specification and application index.

**STANDARD ELECTRICAL PRODUCTS CO.**  
2240 E. THIRD ST. • DAYTON, OHIO, U.S.A.

CIRCLE 60 ON READER-SERVICE CARD FOR MORE INFORMATION

### Digital Kits For Analog Recorders



"Digitizer" Kits can be connected to Minneapolis-Honeywell "Elektronik" null balance recorders to convert analog data such as temperature, pressure, voltage, strain, etc., into

digital form for recording on Clary Printers, punched cards, and perforated tape machines. These kits can be installed in a few minutes without machining of any kind with standard equipment and parts furnished with the assembly.

With this approach, the existing method of recording remains unchanged for direct comparison with the digital data. The accuracy, sensitivity, and response of the recording instrument remains unaltered.

Coleman Engineering Co., Inc., Dept. ED, 6040 W. Jefferson Blvd., Los Angeles 16, Calif.

CIRCLE 61 ON READER-SERVICE CARD FOR MORE INFORMATION

### New X-Band Rotary Joint High Stability

Model H250T/S61 rotary joint is a broad band, high power waveguide coupler designed especially for operation under severe shock and vibration conditions.



Capable of operating at 600 kw peak power for short intervals, the rotary joint will operate at 350 kw during extended use. Impact and vibration tests per MIL-T-17113 show unimpaired mechanical operation and no internal damage.

Preloaded ball bearings provide maximum mechanical reliability and minimum change of electrical characteristics during rotation. VSWR is less than 1.10 over a frequency band of 8400-9600 mcs. Change of VSWR with rotation is less than 0.2 db.

Waveguide and mounting flanges are readily supplied to customer specifications as an integral part of the rotary joint, eliminating blind soldered seams and other potential breakdown points.

Litton Industries, Components Div., Dept. ED, 5873 Rodeo Rd, Los Angeles 16, Calif.

CIRCLE 62 ON READER-SERVICE CARD FOR MORE INFORMATION

## SWITCHBOARD-PROVED Plugs and Jacks



The veteran of telephone equipment suppliers  
**STROMBERG-CARLSON**  
offers you the plugs and jacks which survive the torture test of PBX switchboard work!

No matter what programming or patch panel project you have, we doubt if it will subject plugs and jacks to a tougher test than daily use by a telephone switchboard operator.

We've been making these products for this purpose for over half a century. Their ruggedness and dependability are attested by service records in telephone companies from coast to coast—and in installations of our armed forces all over the world.

A CATALOG of Plugs and Jacks has just come off the press and will be mailed to you on request. Or write to the address below for a specific need you may have.



**STROMBERG-CARLSON**  
A DIVISION OF GENERAL DYNAMICS CORPORATION  
TELEPHONE INDUSTRIAL SALES  
116 CARLSON ROAD, ROCHESTER 3, N. Y.

CIRCLE 63 ON READER-SERVICE CARD

# NEW

*ultra-thin*  
**CHASSIS-TRAK**  
**"DETENT"**  
cabinet slides



give  
easier access  
and mounting  
for  
electronic equipment

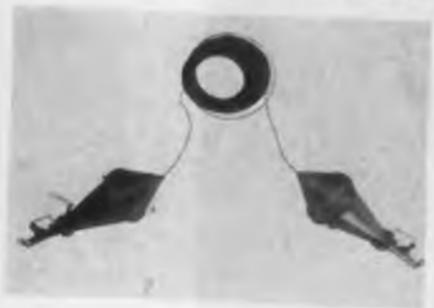
Chassis-Trak "Detent" slides tilt down as well as up to give you ready access to any part of the instrument. Front panel trigger control locks chassis in 7 different tilting positions. Solid bearing surfaces are permanently dry lubricated, glide smoothly without brinnelling or peening under loads up to 175 lbs. Ideal solution to shock or vibration problems. Standard unit accommodates 17" chassis in standard width cabinets 11" to 25" deep. Meets JAN 50-hour salt spray requirements. Now used in many military installations. Available in light, medium, heavy-duty and roller slide models.

write Dept. ED-1 for  
equipment bulletin D-151A

**CHASSIS-TRAK CORPORATION**  
525 SOUTH WEBSTER  
INDIANAPOLIS, INDIANA

CIRCLE 65 ON READER-SERVICE CARD

## Replacement for Coaxial And Waveguide Transmission Line



The G-Line is a new economical single wire surface wave transmission line assembly designed to eliminate coaxial transmission line

and waveguide in low power microwave and television broadcasting.

Designed for high efficiency operation at frequencies from 1700 to 2400 mc, the G-Line assembly consists of a modified copper wire, coupled at each end with identical rf field transformers (launcher and collector). The transformers serve to couple the transmission line ends to the coaxial feed line and provide an efficient transition between the radial field on the wire and the transverse electric field in the coaxial feed line. A simple, highly efficient de-icing system is built into each rf transformer.

Power rating is equal to RETMA 7/8 in. 50 ohm air dielectric line. Operating wire loss is extremely low, +0.5 db per transformer.

The G-Line is simple to install, requiring no bends, complicated plumbing, no pressurization and little maintenance.

Prodelin, Inc., Dept. ED, 307 Bergen Ave., Kearny, N.J.

CIRCLE 66 ON READER-SERVICE CARD FOR MORE INFORMATION

## Potentiometer Rated to 200 C



The Model 875T is a high temperature precision potentiometer rated to 200 C. It is a servo-mount subminiature single-turn rotary precision unit with a power rating of 2 w at 150 C. Despite its small 7/8 in. diameter, linearity is  $\pm 0.5\%$  or better, and resolution is as high as 0.06%. Precious metals are utilized in the coil and wiper to permit low contact pressure and to provide long, noise-free life. Potentiometer coils can be supplied with taps, and as many as six sections can be ganged on a common shaft.

Electromechanical Div., G. M. Giannini & Co., Inc., Dept. ED, 918 E. Green St., Pasadena 1, Calif.

CIRCLE 67 ON READER-SERVICE CARD FOR MORE INFORMATION

Here's how Pacific Automation Products  
makes special Electronic Cable  
easy to procure...

### CABLE PROCUREMENT INFORMATION

By completing the following form you will give us sufficient information for designing a cable for which we will gladly submit price, delivery, and technical data (size, weight, bend radius, etc.).

CABLE NAME OR NUMBER \_\_\_\_\_

TOTAL FOOTAGE \_\_\_\_\_

MINIMUM ALLOWABLE LENGTHS \_\_\_\_\_

UPPER OPERATING TEMPERATURE LIMIT \_\_\_\_\_

LOWER OPERATING TEMPERATURE LIMIT \_\_\_\_\_

APPLICATION (Underwater, buried, severe abrasion, flame, etc.) \_\_\_\_\_

MAXIMUM OPERATING VOLTAGE \_\_\_\_\_ TEST VOLTAGE \_\_\_\_\_

CABLE CIRCUITRY

Wire Size

Type Wire

No. of Conductors

CONNECTORS \_\_\_\_\_

POTTING \_\_\_\_\_

SPECIAL HARDWARE \_\_\_\_\_

BREAKOUTS (Describe) \_\_\_\_\_

ADDITIONAL INFORMATION (color coding, numbering, shielding, etc.) \_\_\_\_\_

YOUR NAME AND TITLE \_\_\_\_\_

COMPANY \_\_\_\_\_

STREET ADDRESS \_\_\_\_\_

CITY AND ZONE \_\_\_\_\_

Fill out this form — clip the department — and  
mail it to us and we will supply the information  
requested. No obligation or name



**Pacific Automation Products, Inc.**

1840 41st AVE. OAKLAND 7, CALIF.

CHAS. 2-3477

1956

1956

1956

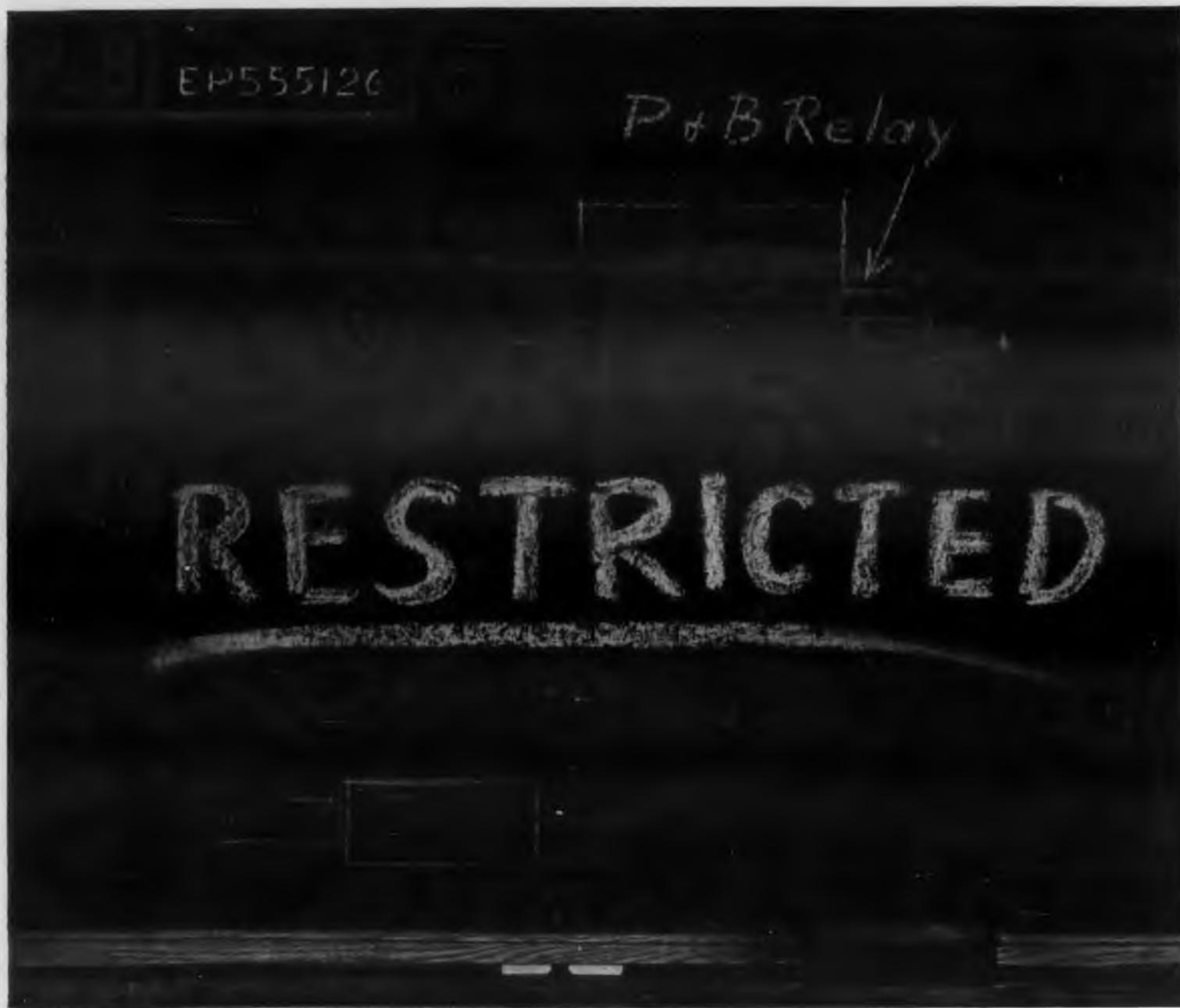
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SON  
ORATION

.Y.

CARD

1956



## P & B answers newest jet bomber relay need puts big performance in tiny package

Modern supersonic aircraft call for an entirely new concept of relay performance *and* miniaturization. Vital relays must have incredible sensitivity . . . multiplicity of action . . . unquestioned reliability. And they must be smaller than ever before!

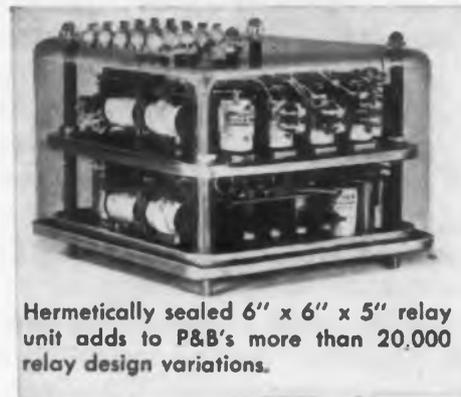
Yet P&B has engineered and produced a relay for the world's most spectacular jet bomber, now in experimental production, that meets *all* these demands.

Though details of application are re-

stricted, we can tell you *this*. The new P&B unit is really 19 individual relays in one 6" x 6" x 5" package that actually *outperforms a previous unit nine times the size!*

Your relay requirements may not be those of a jet bomber. But *whatever* your problem or application, "standard" or special, you can be sure you too will find the answer with the *relay leader* . . . P&B.

Write for your new Engineering Guide today.



Hermetically sealed 6" x 6" x 5" relay unit adds to P&B's more than 20,000 relay design variations.



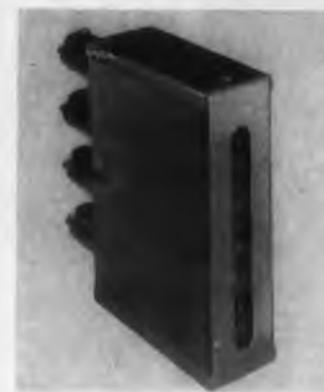
**Potter & Brumfield**  
PRINCETON, INDIANA *inc.*

Subsidiary of AMERICAN MACHINE & FOUNDRY COMPANY

CIRCLE 70 ON READER-SERVICE CARD FOR MORE INFORMATION



### Decade Counters Are Plug-In Units



Decade counters 140-40 and 140-100 are used to count electrical pulses. Functionally, the counters do two things: provide one output for every 10 input pulses, and record on the digit scale the number of pulses that occur after the last output pulse has been delivered.

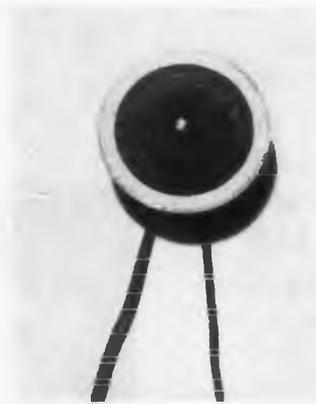
One decade counter is required for each place (units, tens, hundreds, etc.) in the quantity being counted. The counters are connected in cascade, the output pulse of one driving the next in line, each counter dividing its input by 10 and displaying the remainder.

The 140-100 has a max mounting rate of 100 kc and the 140-40 a max rate of 40 kc. Power requirements of these units are 6.3 v ac at 1.2 amp, and +300 v dc at 14 ma. Dimensions are 1-1/2 x 5-1/2 x 5-1/4 in. Weight is 3/4 lb approx.

Northeastern Engineering, Inc., Dept. ED, Manchester, N. H.

CIRCLE 71 ON READER-SERVICE CARD FOR MORE INFORMATION

### Rubber-Housed Light Shock and Vibration Proof



Existing shock and vibration problems in aircraft lighting can be readily overcome by the all-rubber housing of the "Rubber Lamp". Completely encased in rubber, socket and bulb are cushioned against jarring.

Additional features of the design are weather-tightness, ease of installation and maintenance, and application flexibility. Held securely within a lip on the rubber base, snap-out lens, and the lead wires, are sealed dust-and-moisture-proof. Molded body can be fabricated in any desired configuration for panel lights, and aircraft applications, and is slipped quickly in and out of retaining brackets for inspection.

Specifications: 2 1/2 in. over-all body diameter, 1 1/2 in. over-all depth of the lamp, 11/16 in. depth back of the mounting groove, plastic coated, 16 gauge lead wire, and any bulb voltage.

The Lighthouse, Inc., Dept. ED, 2315 Grand Ave., Los Angeles 7, Calif.

CIRCLE 72 ON READER-SERVICE CARD FOR MORE INFORMATION

## Digital Voltmeters Use Mercury Contact Relays



Three digital voltmeters are offered by this firm for applications demanding continuous precision operation. Known as Models 1300, 1400, and 1500, they employ mercury wet-

ted contact relays which assure a life expectancy of more than one billion accurate readings.

Model 1500 (5 digits) has manually-selected ranges of 00.000 to  $\pm 99.999$  v dc with resolution of 0.001 v, and  $\pm 100.00$  to  $\pm 999.99$  v dc with resolution of 0.01 v. This instrument gives three complete readings per second with automatic polarity indication. Absolute accuracy is  $\pm 0.01\%$  of value read, or  $\pm$  one digit. Input impedance is 11 megohms. Size is 10-1/2 x 15-1/2 in., mounting in a standard 19-in. rack.

Model 1400 has a 4-digit readout, and Model 1300 has 3 digits, but they offer the same basic features as the Model 1500.

Non-Linear Systems, Inc., Dept. ED, Del Mar Airport, Del Mar, Calif.

CIRCLE 74 ON READER-SERVICE CARD FOR MORE INFORMATION

## Miniature Potentiometers Meet Military Specs



Designed to meet rugged military specifications, these versatile, 1/4-w miniaturized controls are completely enclosed. They can be sealed or potted,

making them valuable for miniature amplifiers, geophysical equipment, guided missiles, and scores of other applications where small size and high quality are primary factors. There are 28 different selections, all with a tolerance of 20% and in resistance ranges from 1000 ohms to 2.5 megohms.

The model JP has a 1/8-in. diam plain round shaft 1/2-in. long; its bushing is 1/4-in.-32, 1/4-in. long, and is furnished with mounting nut and lock washer. The model JL has a screwdriver slotted shaft of 1/8-in. diam; its split locking bushing is 1/4-in.-32, 3/8-in. long, and is furnished with a jam nut, mounting nut, and lock washer.

Centralab, Div. of Globe-Union, Inc., Dept. ED, 900 E. Keefe Ave., Milwaukee 1, Wisc.

CIRCLE 75 ON READER-SERVICE CARD FOR MORE INFORMATION



# Silicone News

FOR DESIGN ENGINEERS

## SILASTIC PROTECTS BEARING ON MAYTAG CLOTHES DRYER

Over a broad temperature span, from  $-130$  to  $500$  F, Silastic, Dow Corning's silicone rubber, keeps its shape and stays resilient. Here's how Maytag designers have translated this unique thermal stability into practical use in their automatic clothes dryers.

Backbone of the Maytag dryer is a sintered metal journal bearing which supports the drum shaft. This bearing is protected from moisture by a Silastic seal on the shaft. The seal, molded by Maytag, has been in use since the dryer was introduced three years ago.



Despite repeated exposure to steam and ambient temperatures ranging up to  $170$  F, the Silastic seal has demonstrated its ability to remain resilient and watertight for the full service life of the unit. No. 98

## CLASS H MOTOR STILL ON TEST AFTER 58,791 HOURS AT 240 C

At 10 A.M., June 6, 1946, a Class H insulated 10 hp motor was generator loaded to operate at its test temperature of  $240$  C in Dow Corning's motor test labs. Every 500 hours since it has been shut down and exposed to 100% relative humidity for 24 hours. As of 11 A.M. August 1, 1956, this motor was still on test after 58,791 hours at an average copper temperature of  $240$  C! That's equivalent to 358.5 years operation at the Class H temperature of  $180$  C.

ATLANTA • BOSTON • CHICAGO • CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)  
Canada: Dow Corning Silicones Ltd., Toronto; Great Britain: Midland Silicones Ltd., London; France: St. Gobain, Paris

CIRCLE 76 ON READER-SERVICE CARD FOR MORE INFORMATION

## Silicone Coating Cuts Cost of Ceramic Electrical Insulators

Imaginative use of new materials frequently enables designers to create a competitive sales advantage while cutting production costs. Here's a case in point from Centralab Division of Globe-Union Co., Milwaukee.

Centralab reports that a silicone treatment is rapidly replacing conventional glaze coatings on ceramic electrical insulators. Production savings with the silicone treatment range as high as several dollars per thousand units, permitting Centralab to quote competitively for ceramic against ordinary plastic molding materials.



The new treatment consists simply of a dip in Dow Corning 200 Fluid followed by a short baking cycle, contrasted to the costly individual air-brushing and high temperature kiln-firing required for a glazed surface. The silicone treatment gives equivalent or better moisture resistance and surface resistivity for all but the highest frequency applications.

Centralab now offers the silicone treatment on its entire line of steatite-ceramic parts including insulators, capacitor bodies, rotary switches and trimmers. Silicones have become such a strong selling point

## New Silicone Based Paint Signals Danger Temperature

Through ingenious use of heat stable Dow Corning silicone resins, Tempil Corporation, New York City, has developed a paint that provides a visual alarm when surfaces are getting too hot for safety. The new paint, "Temp-Alarm" GA-1", changes color from yellow to maroon at temperatures from  $375$  to  $400$  F.

Currently, this new silicone based coating is used on the exteriors of mixing tanks in steel mills. By changing color at the danger temperature, it warns when the tank's fire brick lining is wearing thin.

Since temperatures involved are relatively low so far as the silicone vehicle is concerned, Tempil has been able to concentrate on the proper pigments for desired color sensitivity without fear of paint failure. Even after prolonged exposure to temperatures just below the "danger" range, the silicone based paint retains its original dependability. No. 99

Documentary film "What's a Silicone?" available free of charge for showings to technical audiences in every industry. In full color and sound, this dramatic 16mm film allows you to see Dow Corning silicones in action improving the performance of products ranging from nursing bottle nipples to diesel locomotives. For more information about this educational film and how to arrange a showing for interested persons in your plant, circle No. 101



Greater moisture repellency of silicone treated ceramic tube socket is demonstrated by dunk test using colored water.

that, as a Centralab spokesman puts it, "Our sales department reviews every order or quotation request calling for glaze and recommends the silicone treatment where ever possible." No. 100

Design Edition 24

DOW CORNING CORPORATION - Dept. 4709  
Midland, Michigan

Please send me 98 99 100 101

NAME \_\_\_\_\_  
TITLE \_\_\_\_\_  
COMPANY \_\_\_\_\_  
STREET \_\_\_\_\_  
CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_



*To users of ceramic parts...*

**is THERMAL SHOCK giving you trouble?**

Stupakoff offers a number of ceramic bodies providing exceptional resistance to thermal shock, the most outstanding being STUPALITH, which has withstood over a hundred cycles from 2000° F to liquid air without harm.

**are HIGH TEMPERATURES your problem?**

Components formed of selected Stupakoff Ceramic Materials will withstand extremely high and prolonged temperatures, without deterioration, even in the presence of many corrosive gases and materials.

**would PRECISION-MADE CERAMICS help speed your production?**

Stupakoff specializes in the mass-production of precision-made ceramic parts and components. Tolerances of  $\pm 0.001$  in. are not unusual. Their use in assemblies of electrical and electronic equipment sharply reduces assembly costs, and assures correct functioning of the equipment in service. This precision is particularly valuable in miniaturized assemblies.

*Write for the new Stupakoff Ceramic Data Chart*

**STUPAKOFF** DIVISION OF  
**The CARBORUNDUM Company**

WRITE DEPT. ED PITTSBURGH, PENNSYLVANIA

CIRCLE 78 ON READER-SERVICE CARD FOR MORE INFORMATION

#### Terminal Lug and Rivet For Subminiature Applications



This terminal lug and rivet are for extremely compact component packages in instrument, electronic, and printed circuit applications involving space requirements smaller than normal subminiature hardware permits. The 24 car-

at gold plated, shot burnished terminal lug is designed with a continuous convex curvature throughout its length to provide maximum pressure per unit area in contact under the rivet with spring tension against the rivet head when it is in place. The 1/32-in. diam rivet, also gold plated, has been designed to fasten the lug.

Both items are non-magnetic and of precision instrument quality for uniform, trouble-free, reliable use. Also available are tools for setting the rivets, designed to be used in any punch press, arbor press, kick press, or even a drill press, at nominal cost.

Circon Component Co., Dept. ED, Santa Barbara Municipal Airport, Goleta, Calif.

CIRCLE 79 ON READER-SERVICE CARD FOR MORE INFORMATION

#### Heavy Duty Relays In Small Size, High Capacity



A series of general purpose, heavy-duty relays, of small size in relation to high capacity, is offered for application in automation systems as well as

in appliances. Designated as "Diamond H" series W Power Relays, they measure only 1-1/2 x 1-1/2 x 1-7/8 in. (excluding terminals) but carry resistive loads up to 25 amp at 115-220 v ac.

Contacts are Type 2 Form Z (dpdt double break). Coils will handle any ac or dc voltages and in breakdown tests exceeded 1500 v rms.

Vibration resistance ranges from 10-55 cps with 1/16 in. total excursion. Spade type terminals make for fast and easy connecting. Side and panel mounting arrangements are standard, but other mounting arrangements are available to meet special requirements.

The Hart Manufacturing Co., Dept. ED, 110 Bartholomew Ave., Hartford, Conn.

CIRCLE 80 ON READER-SERVICE CARD FOR MORE INFORMATION

## SANDERS MINICUBE BLOWER

*ruggedly  
constructed  
for use on aircraft  
and guided  
missiles*



The Sanders Minicube Blower contains both miniature blower and motor in a rugged, 1" cube. A single package, it is designed for use on aircraft and guided missiles operating under severe environmental conditions. It is operable over wide ranges of vibration, acceleration and temperature, and is suitable for many exacting applications.

The Sanders Minicube Blower can be used to:

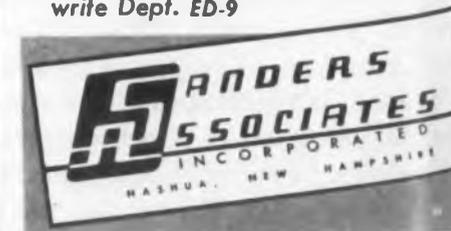
- Eliminate hot spots in subminiature equipment
- Prevent fogging of lens or viewing glasses
- Cool Klystrons and other electronic tubes and devices
- Maintain uniform flow of air in restricted space

#### SPECIFICATIONS

Output: 3 cubic feet of air/minute  
Input: 400 cps, 4 watts  
Voltage: Model 1: 6 volts  
Model 2: 26 volts

Speed: 22,000 RPM  
Size: 1" x 1" x 1"  
Weight: 1 oz.

*For detailed specifications,  
write Dept. ED-9*

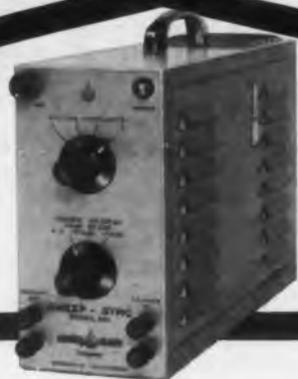
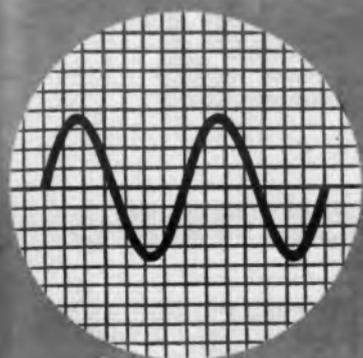


CIRCLE 81 ON READER-SERVICE CARD

## the SWEEP-SYNC

lets you scan  
without distraction

—ADJUSTS THE CRO SWEEP  
AUTOMATICALLY DURING  
WAVESHAPES CHECKING



No more fiddling with oscilloscope controls every time you change frequencies. A SWEEP-SYNC hooked up to your CRO adjusts automatically to each new frequency. You get an ideal display throughout continuous scanning. You never lose the display of a preset number of cycles. With no distracting sweep control changes needed, you can concentrate on productive work, and get much more done.

Trigger input—any waveshape 5 cps to 100,000 cps. Output is sawtooth, approximately 10 V.P.P. Applications include sine wave, pulse and square wave testing. The SWEEP-SYNC saves time in circuit development, production testing and waveshape monitoring... makes many visual techniques practical. Occupies only 4" of front panel width. Write for literature.



**CHADWICK  
HELMUTH  
COMPANY**

472 East Duarte Road  
Monrovia, California

CIRCLE 83 ON READER-SERVICE CARD

### Delay Lines Continuously Variable Units



Seven continuously variable delay lines are offered for use as components or as test equipment in the design and development of advanced computer and radar systems. In these lines, a single control shaft, in 10 turns, covers the entire delay range from zero to maximum delay. A locknut attachment can be supplied to lock as desired delay. Therefore, the lines can be used as components in equipment with a fixed delay, or as continuously variable units.

Attenuation in these units is less than 1.0 db. Resolution is better than 0.001  $\mu$ sec. Termination is external. Outside dimensions are 6-17/32 x 5/8 x 1-1/4 in. The units meet all applicable Mil specs. Delays are available from 0.10  $\mu$ sec (max to 0.70  $\mu$ sec (max), in rise times from 0.25  $\mu$ sec to 0.60  $\mu$ sec. In addition this firm can supply custom-designed units.

ESC Corporation, Dept. ED, 534 Bergen Blvd., Palisades Park, N.J.

CIRCLE 84 ON READER-SERVICE CARD FOR MORE INFORMATION

### DC Power Supplies With Voltages to 30 kv



The Models 15BR and 30BR are resonant transformer rf type high-voltage supplies particularly well suited to the requirements of low ripple, fine regulation, and maximum safety. The high frequency power is generated by two self-oscillating power tubes. The rectifier is air insulated and consists of a single half-wave rectifier in the Model 15BR and a doubler half-wave rectifier in the Model 30BR. Corona and flashover are virtually non-existent.

Regulation is obtained by comparison of a sample of the output with a constant voltage, and the difference is fed to a dc amplifier which controls the screen voltage of the power tubes.

Voltage range of the two units is 2-15 kv and 5-30 kv dc, with current output of 1 ma at 10 kv and 1 ma at 20 kv respectively. Regulation of both units is better than 1 per cent. Input is 117 v 60 cps. Size is 7-1/4 x 10 x 8 in. and 7-1/4 x 14 x 8 in. respectively.

Neutronic Associates, Dept. ED, 87-16 116th St., Richmond Hill 18, N. Y.

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the QUICK answer to  
Stressed Panel Fastener  
problems...

CAMLOC

SPF<sup>®</sup>

HIGH STRENGTH  
ROTARY  
FASTENER



SPF eliminates shortcomings of other methods of  
securing removable structural panels...

- gives all the advantages of a thread plus continuous thread engagement
- overcomes cross-threading and stripping
- fastens and unfastens in less than a full turn
- compensates for "warping" or "spring-back" of panels
- saves on structural weight and maintenance time
- provides positive clamping force of a bolt
- prevents deflection under loads



Get a quick answer to your  
stressed panel fastening  
problems. Write for  
Catalog No. SPF 56 today!

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"Specialists in fasteners for Industry"

**FASTENER CORPORATION**  
61 Spring Valley Road, Paramus, N. J.

WEST COAST OFFICE: 5410 WILSHIRE BLVD., LOS ANGELES, CAL.  
CIRCLE 86 ON READER-SERVICE CARD FOR MORE INFORMATION

0 CPS to 1 MC!  
DIRECT READING



new

Computer-Measurements Model 226A

### UNIVERSAL COUNTER-TIMER

#### OUTSTANDING FEATURES:

- ★ Three independent, adjustable trigger level controls permitting full rated sensitivity at any voltage level between 300 and 300 volts.
- ★ Small voltage increments ordinarily masked by attenuators are easily selected.
- ★ Simplified color-coded controls and direct read-out in kc, mc, sec, or millise, with automatic decimal point indication.
- ★ Oscilloscope marker signals facilitate start and stop trigger level adjustment for time interval measurement of complex waveforms.

A brand new multi-purpose instrument provides precision measurement of frequency, frequency ratio, period (1 frequency), and time interval. Pressure, velocity, acceleration, displacement, flow, RPS, RPM, etc., may also be measured with suitable transducers. The 226A may be used as a secondary frequency standard.

price \$1,100.00

Long Term: 3 parts per million per week  
 Display Time: Automatic: Continuously variable 0.1 to 10 seconds  
 Manual: Until reset  
 Input Impedance: 1 megohm and 50 mmf  
 Trigger Level: Continuously adjustable from -300 to +300 volts  
 Accuracy:  $\pm 1$  count  $\pm$  stability  
 Secondary Frequency Standard: 1 mc; 100, 10, 1 kc; 100, 10, and 1 cps  
 Dimensions: 17" W x 8 3/4" H x 13 1/2" D approx.  
 Weight: 50 lbs. approx.



### MODEL 225A 0 cps-100 kc UNIVERSAL COUNTER-TIMER

Similar to the 226A in design. Featuring Oscilloscope Trigger Level Marker Signals; Three Direct-Coupled Inputs of 70 mv sensitivity; Direct Reading, Automatic Illuminated Decimal Point. Easily portable. Price: \$840.00

Data Subject to Change Without Notice - Prices F.O.B. Factory

Write for complete specifications on the new 226A and the 225A models and the complete CMC line of electronic counting and controlling equipment.

**Computer-Measurements Corporation**

5528 Vineland Avenue, North Hollywood, Calif. Dept. 76-J

CIRCLE 88 ON READER-SERVICE CARD FOR MORE INFORMATION

## FREQUENCY

### SPECIFICATIONS:

#### FREQUENCY MEASUREMENT

Frequency Range: 0-1,000,000 cycles per second  
 Input Sensitivity: 0.2 volt rms. Direct-coupled input  
 Time Bases: 0.00001, 0.0001, 0.001, 0.01, 0.1, 1 and 10 seconds. Also can use external 0-1 mc standard

#### PERIOD MEASUREMENT

Period Range: 10 microseconds to 1,000,000 seconds  
 Frequency Range: 0.000001 cps to 100 kc  
 Input Sensitivity: 0.2 volts rms. Direct-coupled input

#### Gate Times:

1 and 10 cycles of unknown frequency  
 Standard Frequency Counted: 1 mc; 100, 10, 1 kc; 100, 10, 1 cps; external 0-1 mc.

#### TIME INTERVAL MEASUREMENT

Range: 3 microseconds to 1,000,000 seconds  
 Start and Stop: Two independent or common channels Positive or negative slope  
 Input Sensitivity: 0.2 volts rms. Direct-coupled input  
 Standard Frequency Counted: 1 mc; 100, 10, 1 kc; 100, 10, 1 cps; external 0-1 mc.

#### GENERAL

Stability: Short Term: 1 part in 1,000,000 (temperature-regulated crystal)

## Plastic Insulation

### Reinforced but Flexible



Grade FM is a low cost glass-mat polyester plastic insulation available in flexible form suitable for bending around corners or wrapping in cylindrical forms. It is heavy enough to give substantial mechanical support, flexible enough (in 1/32 in. thickness) to bend to a 3 in. diam without loss in dielectric strength, and heat-resistant enough to withstand continuous exposure to Class B temperatures (130 C) without loss in dielectric strength.

The material provides savings both in labor and material cost, due to the need for less wraps because of greater thickness. It offers excellent dimensional stability and low moisture absorption even after prolonged heat exposure. It is valuable for motor and generator phase insulation, transformer core wrapping and end filler stock, curved barriers for switch gear, and other applications where flexible Class B insulation is required. It is currently available in standard thicknesses of 1/32, 3/64, and 1/16 in., in sheet sizes up to 36 x 72 in.

The Glastic Corp., Dept. ED, 4321 Glenridge Rd., Cleveland 21, Ohio.

CIRCLE 89 ON READER-SERVICE CARD FOR MORE INFORMATION

## Gear Box

### Has Two Outputs



Available in a wide variety of ratio combinations, the Dual Output Gear Box, Model 013, provides primary and secondary output shafts for use in servo systems where two constant ratio outputs are required. The unit minimizes space consuming gear arrangements, and in some instances it completely eliminates a servo system which may otherwise be needed to provide the additional output.

The gear box is adaptable to scaling problems where two different operating speeds are required, or where one fast positioning speed and a slower speed are needed, as in recorders. It may also be used where a constant ratio is required between any two functions—minutes/seconds, hours/minutes, days/hours, etc. Adapter kits are available to facilitate utilization with various standard servo motors.

Link Aviation Inc., Dept. ED, Binghamton, N.Y.

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## permanent magnets

Thomas & Skinner offers a complete line of alloy steel and Alnico Grade permanent magnets to meet every industrial requirement — no matter how specialized.

Thomas & Skinner 17% and 37% cobalt steels are recommended for hysteresis motor applications. The Alnico grades, either conventionally cast or fill moulded, find use in thousands of applications . . . magnetos, motors, generators, meters, microwave applications and many others.

T&S furnishes all Alnico Grades —including T&S's Alnico 5Cb. Incorporating *columbium* for increased stability, Alnico 5Cb has a nominal energy product of  $5.70 \times 10^6$ , offering unusually high magnetic value for low physical volume.

Besides complete assurance of quality and specification conformity, T&S offers its highly qualified engineering assistance—based on more than 50 years experience in the magnetic materials industry—to help you select the permanent magnets best suited for your applications.

Write today for Bulletin No. 151.



Specialists in magnetic materials

**THOMAS & SKINNER, INC.**

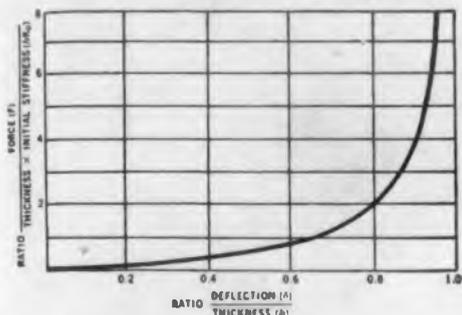
INDIANAPOLIS, INDIANA

1157 East 23rd Street  
CIRCLE 91 ON READER-SERVICE CARD

## How to Design for Isolation during Sustained Acceleration

It is becoming increasingly important that vibration isolators continue to provide isolation during sustained acceleration. This is a requirement in some classes of guided missiles. If the force-deflection characteristic of the isolator is linear, it is easy to calculate the required deflection by multiplying the static deflection of the isolator under the deadweight load by the sustained acceleration expressed as a dimensionless multiple of the gravitational acceleration.

Unless it has clearances at least equal to this calculated deflection, the isolator bottoms during the sustained acceleration, and provides no vibration isolation. One way to alleviate this effect is to use an isolator hav-



ing non-linear force deflection characteristics, as shown by this dimensionless curve and defined by the equation

$$\frac{\delta}{h} = \frac{2}{\pi} \tan^{-1} \left[ 15.37 \left( \frac{\ddot{x}_s}{f_0^2 h} \right) \right]$$

where  $\delta$  is the deflection of the isolator under the sustained acceleration  $\ddot{x}_s$ , is the natural frequency under normal deadweight load, and  $h$  is the "effective thickness" of the load-carrying spring.

When sustained acceleration increases the static force on the isolator, deflection increases, but less than if the stiffness of the isolator were linear. This increase in deflection is accompanied by an increase in stiffness; i.e., by an increase in the slope of the force-deflection curve. The effective natural frequency is thus increased because there is no increase in mass, and the transmissibility increases.

To simplify the evaluation of changes in transmissibility, we have prepared a nomograph and set of curves for graphic solution of this problem. Write for your free copy of these useful design data — Bulletin #THO-5.

From "Natural Frequency of a Nonlinear System Subjected to a Nonmassive Load", Transactions ASME, January, 1954.

Barry's new Western Division, in Burbank, California, offers fast, on-the-spot design and prototype service, and production of special systems.

BARRY B MOUNT

**BARRY  
CONTROLS**

INCORPORATED  
SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES

775 PLEASANT ST., WATERTOWN 72, MASS.

CIRCLE 93 ON READER-SERVICE CARD

## Precision Potentiometer Close Tolerance



Precision potentiometers are 2 in. diam single-turn units for servo or bushing mounting, with or without ball bearings; up to 8 sections can be ganged on a common shaft at

the factory, with as many as 21 taps to a section.

A wide range of total resistance is provided, from 35 to 80,000 ohms, and linearity as close as  $\pm 0.15\%$  is available.

The series 5600 is a continuous-rotation potentiometer, with electrical rotation of  $356^\circ \pm 1^\circ$ . Housed in a dimensionally stable, one-piece plastic cup, it weighs 3.2 ozs. Operating range is  $-55$  to  $+80$  C. Power rating is 4.8 at 25 C ambient and 3.5 at 40 C ambient.

Helipot Corp., Dept. ED, Newport Beach, Calif.

CIRCLE 94 ON READER-SERVICE CARD FOR MORE INFORMATION

## Standard Capacitor Provides 0.2% Accuracy



A precision decade three-terminal standard capacitor, the Type FT-KGM has an accuracy of 0.2%.

It is designed for use as a laboratory standard, for calibration of capacitance bridges and meters, for development and laboratory testing of integrators, computers, and low-level ac amplifiers, for a variety of circuit measurements, and for use as a component in laboratory constructed circuits, such as bridges.

The three terminals permit the unit to be used as a grounded or ungrounded component, as desired. It, also, has double shielding which may be interconnected. Owing to the capacitor's high resonant frequency (approximately 0.35-11 mc, depending on the capacitance switched in) the FT-KGM is useful over a wide frequency range. Total capacitance range of the unit extends from 100 mmfd to 1.00 mfd. Settings are made on three decade scales and one continuously variable air capacitor scale. The units weigh 22 lb and are 9 x 9 x 12-1/2 in. wide.

Federal Telephone and Radio Co., Instrument Div., Dept. ED, 100 Kingsland Rd., Clifton, N.J.

CIRCLE 95 ON READER-SERVICE CARD FOR MORE INFORMATION

## Kearfott FERRITE MICROWAVE COMPONENTS

### KEARFOTT FERRITE DUPLEXERS

Improvements in recovery time, reduction in insertion loss and excellent magnetron isolation are performance benefits offered by Kearfott Ferrite Duplexers — designed to meet specific radar space requirements.



A Faraday rotation type unit is illustrated. A type and configuration is available for your requirements.

### KEARFOTT FERRITE ISOLATORS

For superior performance KEARFOTT ISOLATORS custom designed to fit the exact combination of characteristics, available space and configuration for your radar system. For high or low power — for broad or narrow band use and with db ratios of isolation to insertion up to 150 to 1.



Kearfott offers 3 types of Ferrite Isolators to assure the optimum performance of all microwave applications.

### KEARFOTT FERRITE ATTENUATORS AND SWITCHES

Ferrites offer new circuit possibilities and product improvement for AGC and electronic switching of R.F. energy. Kearfott designs, precisely tailored to your most exacting requirements, assure maximum performance and reliability with minimum weight.



The 30 db variable attenuator illustrated, requires less than 3 watts control power.

Write for information on multi-purpose R.F. Test Sets. Available from stock — for X-Band, Ku Band and C Band

**Kearfott COMPANY, INC.**  
LITTLE FALLS, NEW JERSEY  
WESTERN DIVISION  
233 VINEDO AVE., PASADENA, CALIF.

EASTERN OFFICE  
1378 Main Ave.  
Clifton, N. J.

MIDWEST OFFICE  
188 W. Randolph St.  
Chicago, Ill.

SOUTH CENTRAL OFFICE  
6115 Denton Drive  
Dallas, Texas

CIRCLE 96 ON READER-SERVICE CARD FOR MORE INFORMATION

## Power Generators

Provide up to 100 va



Model DP line of Electronic Power Generators, capable of delivering up to 100 va of low-distortion power at any fixed frequency between

50 and 5000 cps, is available for laboratory and production applications. These instruments feature an accurate 4 in. meter that continuously monitors the generated voltage, in both stand-by and operating conditions.

Four standard models (400, 1000, 1600, and 2000 cps) are available in two versions: single, factory set frequency, or variable frequency, panel-controlled over a range of  $\pm 5\%$  of nominal. Any non-standard out put frequency can be specified, and tuning fork-stabilized instruments similarly can be tailored to meet exact requirements.

Long term frequency drift is less than 1% from no load to full load with a transient recovery time of approximately 10 ms. Model DP measures approximately 17 1/2 x 9 x 11 in. deep and weighs 60 lb. It can also be provided in a standard 19 in. rack mounting.

Trio Laboratories, Inc., Dept. ED, 4025 Merrick Rd., Seaford, N.Y.

CIRCLE 98 ON READER-SERVICE CARD FOR MORE INFORMATION

## Angle Socket

Used in Printed Circuits



This new angle socket has been designed for use in electrical and electronic units in conjunction with printed circuits. The socket provides for the

mounting of tubes in units where there is limited height, and for maintenance and servicing accessibility where circuit boards are plugged vertically into larger units or terminal strips.

Extreme structural rigidity is provided by supplementary buttress ribs which maintain the angle position of the socket to the printed circuit. Structurally, the ribs will withstand great pressure so that the socket cannot be bent out of position or torn from the circuit board.

Cleveland Metal Specialties, Dept. ED, 1783 21st St., Cleveland 14, Ohio.

CIRCLE 99 ON READER-SERVICE CARD FOR MORE INFORMATION



Model R



### Note these special features:

- AM, FM, CW, MCW, and PULSE reception.
- Uni-dial control.
- Direct reading.
- Broadband coverage.
- Output level reading directly in db.
- High sensitivity.
- Seven interchangeable plug-in r-f tuning units cover the entire frequency range.
- Low noise figure; excellent gain stability.
- Microwave preselection, tracked and double-tuned, used in the plug-in tuning units covering the range 400 to 11,260 mc.
- Audio, video, and trigger outputs.
- Special recorder output.
- High video output—low impedance.
- AGC and AFC circuits.

### For these applications:

- General communications.
- Field intensity meter.
- Frequency meter.
- Measurement of radiation and leakage of microwave devices.
- Measurement of bandwidth of microwave cavities.
- Measurement of relative power of fundamental and harmonic signal frequencies.
- Measurement of noise figure.
- Antenna field patterns.

CIRCLE 100 ON READER-SERVICE CARD FOR MORE INFORMATION

# NEW

# EXTENDED RANGE MICROWAVE RECEIVER! 400 to 22,000 mc



## SPECIFICATIONS:

**Basic Receiver: Model R-B**  
**Tuning Unit Frequency Ranges:**  
 Model RR-T ..... 400 — 1,000 mc  
 Model RL-T ..... 950 — 2,040 mc  
 Model RS-T ..... 1,890 — 4,320 mc  
 Model RM-T ..... 4,190 — 7,720 mc  
 Model RX-T ..... 7,260 — 11,260 mc  
 Model RKS-T ..... 9,500 — 15,600 mc  
 Model RKU-T ..... 14,700 — 22,000 mc

**Signal Capabilities:**  
 AM, FM, CW, MCW, pulse

**Sensitivity:**  
 (a) For Model RR-T: Minus 85 dbm  
 (b) For Models RL-T, RS-T, RM-T, and RX-T: Minus 80 dbm  
 (c) For Models RKS-T and RKU-T: Minus 65 dbm

**Frequency Accuracy: ±1%**  
**IF Bandwidth: 3 mc**  
**Video Bandwidth: 2 mc**  
**Image Rejection:**  
 (a) For Models RR-T thru RX-T: Greater than 60 db

Three new r-f tuning units double the frequency range of the well-known Polarad Microwave Receiver. Now more than ever the Model R becomes a basic multi-purpose instrument for microwave research and production in the field, in the laboratory, and in the factory.

This receiver is designed for quantitative analysis of microwave signals and is ideal for the reception and monitoring of all types of radio and radar communications within the broadband 400 to 22,000 mc. It permits comparative power and frequency measurements, by means of its panel-mounted meter, of virtually every type of signal encountered in microwave work.

It is compact and functional, featuring 7 integrally designed plug-in, interchangeable RF microwave tuning units to cover 400 to 22,000 mc; non-contacting chokes in pre-selector and microwave oscillator to assure long life and reliability; and large scale indicating meter for fine tuning control.

Call any Polarad representative or direct to the factory for detailed specifications.

(b) For Models RKS-T and RKU-T:  
 Spurious response rejection obtained through the use of a bandpass filter

**Gain Stability with AFC: ±2 db**  
**Automatic Frequency Control:**  
 Pull-out range 10 mc off center

**Recorder Output: 1 ma. full scale (1,500 ohms)**  
**Trigger Output:**  
 Positive 10-volt pulse across 100 ohms

**Audio Output:**  
 5 volts undistorted, across 500 ohms

**FM Discriminator:**  
 Deviation Sensitivity: .7 v./mc

**Skirt Selectivity:**  
 60 db — 6 db bandwidth ratio less than 5:1

**IF Rejection: 60 db**

**Input AC Power:**  
 115, 230 V ac, 60 cps, 440 watts

**Input Impedance:**  
 Models RR-T through RX-T: 50 ohms  
 Models RKS-T & RKU-T: waveguide

**VSWR: Less than 4:1 over the band**  
**Range of Linearity: 60 db**  
**Receiver Type: Superheterodyne**  
**Maximum Acceptable Input**  
 Signal Amplitude: 0.1 volt rms, without external attenuation

**Video Response: 30 cps to 2 mc**  
**Size: 17" w x 23" d x 19" h**  
**Weight: 180 lbs. for basic unit with one tuning unit.**

**Price:**

Model R-B (basic unit)	\$1,500
Model RR-T	2,800
Model RL-T	2,800
Model RS-T	2,800
Model RM-T	2,800
Model RX-T	2,800
Model RKS-T	2,800
Model RKU-T	2,800

**Note:** To the basic cost of \$1,500 add cost of tuning units required.  
 Prices subject to change without notice

AVAILABLE ON EQUIPMENT LEASE PLAN



**ELECTRONICS CORPORATION**  
 43-20 34th Street • Long Island City 1, New York

REPRESENTATIVES: Albuquerque, Atlanta, Baltimore, Boston, Buffalo, Chicago, Cleveland, Dayton, Denver, Fort Worth, Kansas City, Los Angeles, New York, Philadelphia, Portland, St. Louis, San Francisco, Schenectady, Syracuse, Washington, D. C., Winston-Salem, Canada; Arnprior, Ontario. Resident Representatives in Principal Foreign Cities

CIRCLE 100 ON READER-SERVICE CARD FOR MORE INFORMATION

## 18 lb Alternator In Ratings up to 750 va



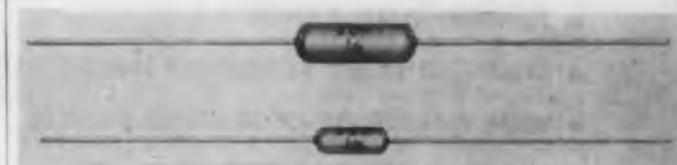
An improved version of the "Nobrush" Alternator is offered in ratings up to 750 va, three phase. They include such features as: light weight, small size, high efficiency, freedom from rf disturbance, immunity to damage by overload and short circuit, and resistance to impairment by dust, grit, or moisture. Improvements in the basic design result in greater rigidity of frame, more rugged shaft design, improved ventilation, and more thorough stator insulation. Maintenance problems have been reduced virtually to bearing attention; for intermittent duty, this attention is obviated by use of sealed-for-life ball bearings.

Greater flexibility in output voltages and in multiple voltages has been attained. Single phase ratings range from 125 va to 500 va. Ratings from 125 va to 750 va, three phase, are available. The alternator has dimensions of 7 x 7-5/8 x 8-1/8 in., exclusive of shaft, and weight is 18 lb. For many applications, intrinsic regulation is adequate, obviating regulating equipment. The alternator may be mounted in any position and works equally well with clock-wise or counter-clockwise rotation. By addition of rectifiers, a brushless dc generator may be obtained.

Georator Corp., Dept. ED, Manassas, Va.

CIRCLE 102 ON READER-SERVICE CARD FOR MORE INFORMATION

## Molded Resistors Meet MIL-R-10509B



Made to meet or exceed MIL-R-10509B, the DCM 1/8 and DCM 1/4 molded deposited carbon resistors are rated 1/8 w and 1/4 w respectively. They are designed for applications requiring precision, stability, and small physical size. They are doubly insulated, resulting in better mechanical protection, long load life, high electrical insulation, and high resistance to moisture.

The DCM 1/8 has a resistance range of 10 ohms to 1 megohm, length of 13/32 in., diameter of 0.136 in., and a lead length of 1-1/2 in. The DCM 1/4 has a 5 ohm to 1 megohm range, a length of 19/32 in., a 0.219 in. diameter, and a lead length of 1-1/2 in.

Electra Manufacturing Co., Dept. ED, 4051 Broadway, Kansas City, Mo.

CIRCLE 103 ON READER-SERVICE CARD FOR MORE INFORMATION

**Immediate  
maintenance  
available by field  
service specialists**



Got A Small  
"Black Box"  
Crammed full  
of Electronic  
Equipment?



**FITS RIGHT  
INTO  
THE PICTURE**



**The Model "M" ACRO micro-switch**

**Unsurpassed in all these ways...**

- REPEATABILITY
- FUNGUS PROOF
- VIBRATION RESISTANT
- LOW CONTACT RESISTANCE
- TEMPERATURE RANGE +165° F. to -90° F.
- DIMENSIONALLY STABLE AT ABOVE TEMPERATURES
- WIDE RANGE OF OPERATING FORCES
- CLOSE MOVEMENT DIFFERENTIALS

**HELPFUL SWITCH APPLICATION GUIDE**

Whether your problem is meeting rigid government specifications for weather and altitude or controlling circuits on sensitive electronic equipment, this data in charted form will greatly simplify your switch selection. Write for Data Sheet M-1.

**"The Biggest Line of Little Switches"**

**ACRO** ACRO SWITCH  
DIVISION  
**MANUFACTURING COMPANY**

COLUMBUS 16, OHIO

Plants at Columbus and Hillsboro, Ohio

REPRESENTATIVES IN ALL PRINCIPAL CITIES

CIRCLE 106 ON READER-SERVICE CARD FOR MORE INFORMATION

**Transducer  
Detects Small Flaws**



The "High Resolving Transducer" can detect small flaws close to the surface of a specimen by ultra-

sonic echo sounding methods. This transducer is also to differentiate between two defects in the same minute area.

When a 10-mc 3/4-in. diam high resolution transducer is used with a suitable instrument (such as the Curtiss-Wright "Immerscope") it is possible to detect a round plane flaw of only 0.0017-sq in. area at a distance of only 0.1 in. below the top surface of an aluminum specimen.

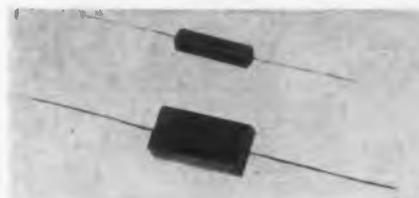
These transducers are also available modified to meet special requirements, such as: special acoustic matching to the immersion fluid; beam focusing to any reasonable depth; and special shapes, such as a rectangular broad-beam "paint brush" style, for rapid automatic scanning of large surfaces. Broad-beam transducers up to 6 in. wide have already been delivered.

Industrial and Scientific Products Div., Curtiss-Wright Corp., Dept. ED, Caldwell, N.J.

CIRCLE 107 ON READER-SERVICE CARD FOR MORE INFORMATION

**Polystyrene Capacitors**

**Both Round and Flat**



A line of molded polystyrene capacitors is offered in both round and flat molded configurations.

The units are designed for all phases of the electronics industry with particular emphasis on radio and TV equipment. They provide high insulation resistance, low dielectric absorption, good stability, a linear temperature coefficient, and a "Q" of greater than 2000.

Both the flat and round models are of extended foil construction, molded in a thermosetting alkyd resin, and have axial leads. Inserted tab construction and special lead configurations also are available. Dielectric absorption is 0.05%, with insulation resistance at 25 C of  $1 \times 10^{12}$  ohms. Power factor at 1 kc is a maximum of 0.05%. Temperature range is -55 to +85 C, with coefficient of -100 parts per million per deg. The capacitance range is 0.0001 mfd to 1 mfd.

Condenser Products Co., Div. New Haven Clock & Watch Co., Dept. ED, 140 Hamilton St., New Haven, Conn.

CIRCLE 108 ON READER-SERVICE CARD FOR MORE INFORMATION

**KEL-F® Plastic**  
**grade 500**

**New fluorocarbon plastic formulation provides wire insulation that can withstand continuous operating temperature up to 175°C.**

KEL-F PLASTIC, Grade 500—like all the molding compounds in the KEL-F fluorocarbon series—is notable for its extreme resistance to high temperatures, chemical attack, humidity and abrasion.

Of special interest to the electrical field is the higher heat-aging level of wire coatings with the new Grade 500. Tests on wire insulation indicate a continuous operating range of temperatures up to 175°C. Samples of coated wire exposed to temperatures as high as 190°C. for extended periods of time (2-3 months) still maintain relatively high voltage breakdown values.

**TWO TYPES AVAILABLE**

**GRADE 500-F**, a less crystalline type that resists embrittlement by high temperatures. Recommended for general wire and cable insulation, hook-up wire, thin wall tubing, and spaghetti.

**GRADE 500-R**, possesses same general properties as F type, only a slightly more rigid formulation. Recommended for use in connector insulation and for coil forms.

**MOLDABILITY**

The new Grade 500 permits extrusion of high molecular weight coatings and thin wall tubing that resist embrittlement when exposed to higher temperatures.

**TECHNICAL SERVICE**

Our Technical Customer Service staff will be happy to work with you in developing specific applications for the new Grade 500. Send for your copy of the first report on KEL-F PLASTIC, Grade 500. Write:

**THE M. W. KELLOGG COMPANY**  
Subsidiary of Pullman Incorporated  
Chemical Manufacturing Division  
P. O. Box 469, Jersey City, N. J.



® KEL-F is the registered trademark of The M. W. Kellogg Co. for its fluorocarbon products.

CIRCLE 109 ON READER-SERVICE CARD  
CIRCLE 395 ON READER-SERVICE CARD



Starting half a century ago, Stackpole engineering centered around two of the most basic, versatile elements . . . carbon and graphite. Singly, in combination or mixed with metal powders, these age-old elements were developed into materials and components that consistently met advanced engineering requirements in many fields.

With the commercial advent of radio, this specialized experience provided a head start for the production of composition resistors.

Thus established in 1928, the Stackpole Electronic Components Division expanded rapidly in full keeping with the remarkable growth of the industries it serves.

Today's electronic lines, as illustrated on the following pages, offer convincing evidence of the progress that has been made . . . progress that continues today at an accelerated pace.

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1956

**pace**

**ELECTRICAL-  
ELECTRONIC  
COMPONENT**

**Progress**

**I**n addition to complete ranges of standard component types listed here, Stackpole regularly develops and produces special designs and adaptations for quantity users. Full details on any Stackpole component gladly sent on request.



★ 50<sup>th</sup> YEAR  
**STACKPOLE**  
★ ★

**STACKPOLE  
COMPONENTS  
in 1928**

This sample kit of almost 30 years ago includes Stackpole fixed and variable resistors and automotive ignition suppressors.



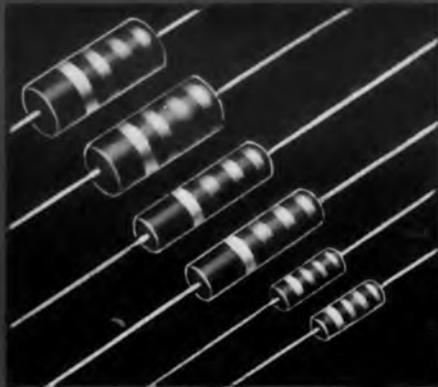
*Electronic Components Division*  
**STACKPOLE CARBON COMPANY, St. Marys, Pa.**  
Plants in St. Marys, Pa. (2); Kane, Pa. (3); Johnsonburg, Pa.  
and Toronto, Ontario.

## STACKPOLE

### FIXED Composition RESISTORS

Stackpole's position as one of today's major resistor suppliers is based on two factors: (1) Consistently dependable, quality-controlled resistors; and (2) close personal service in matching resistor requirements and in assuring "on time" deliveries.

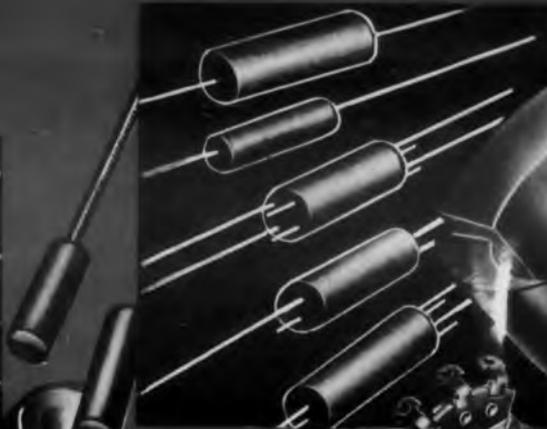
$\frac{1}{2}$ -, 1- and 2-watt sizes are supplied in all standard RETMA ranges and tolerances.



## STACKPOLE

### MOLDED COIL FORMS

Standardized, low-cost types stocked for prompt delivery. Molded of high-resistance powdered iron with firmly-anchored, easy-to-solder wire leads.



## STACKPOLE

### FERROMAGNETIC CORES

Whether ferromagnetic cores are small, Stackpole Ceramag cores have set the quality standards. Characteristics are maintained with remarkable uniformity regardless of size or shape. Write for Bulletin RC-10E.



## STACKPOLE

### SLIDE SWITCHES

Over 20 inexpensive types for radio and TV receivers, instruments, appliances, small motors, electrical toys, battery-operated lighting circuits and many others. Switch Bulletin RC-10D sent on request.

## STACKPOLE

### POWDERED IRON CORES

Outstandingly uniform. Insert, cup, sleeve, threaded, choke coil, side-molded and plain core types. Stackpole Preferred Type "EE" cores meet 8 out of 10 needs at prices substantially less than custom cores.

## STACKPOLE

### LINE SWITCHES

Types to provide practically any switching arrangement for Stackpole Variable Resistors. Similar switches with outside toggles provide dependable switching for record changers, push-button tuners and other units.

## STACKPOLE

### PERMANENT MAGNETS

These new, low cost ceramic magnets are extremely resistant to demagnetization, even when exposed to strong opposing fields. Use no critical materials. Are virtually electrical non-conductors. Require no "keepers" or other closed-circuit conditions. Write for new Stackpole Ceramagnet Bulletin RC-10A.

## STACKPOLE

### VARIABLE RESISTORS

Single, concentric shaft duals, and new midgets including types for transistorized sets. Write for handy Volume Control Chart for quick guide to Stackpole standard units.

## STACKPOLE

### LOW VALUE CAPACITORS

The simplest, most economical fixed composition capacitor types yet produced. Operating stability is adequate for the great majority of uses. Values from 0.10 to 10.0  $\mu\mu\text{f}$ , each stamped with RETMA color code.

★ 50<sup>th</sup> YEAR  
**STACKPOLE** ★ ★

**"Everything in  
 Carbon but  
 Diamonds!"**



**POROUS CARBON**



**BRUSHES**  
 for all rotating electrical equipment



**POWER TUBE ANODES**



**BEARINGS**



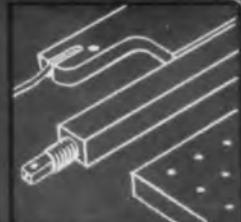
**Metal powder and rare metal  
 CONTACTS**



**SEAL and  
 CLUTCH RINGS**



**DASH POT PLUNGERS**



**GRAPHITE  
 CHEMICAL  
 ANODES**

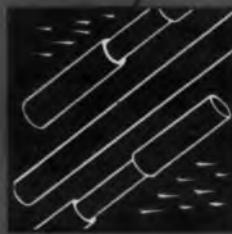


**GROUNDING ANODES**



**FRICTION SEGMENTS**

**BRAZING BOATS**



**ELECTRIC FURNACE  
 HEATING ELEMENTS**



**MOLDS and DIES**



**RESISTANCE  
 WELDING and  
 BRAZING TIPS**



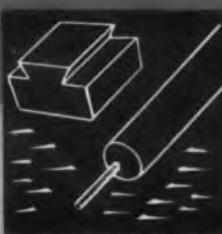
**PUMP VANES**



**VOLTAGE  
 REGULATOR  
 DISCS**



**TROLLEY and  
 PANTAGRAPH  
 SHOES**



**WATER HEATING  
 and  
 PASTEURIZATION  
 ELECTRODES**



**SALT BATH  
 RECTIFICATION RODS**



**WELDING RODS  
 and PASTE**

In addition to the Electronic Components shown on the preceding pages, Stackpole makes the Carbon, Graphite and Metal Powder products illustrated above. Write for details on any product.

**STACKPOLE CARBON COMPANY, St. Marys, Pa.**

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**CHICAGO  
MAGNETIC**  
solves  
problems  
in

TRANSFORMERS  
TUNED FILTERS

**creative  
engineering**

such as this\*

## Paired Filters



**Matched**

to tolerances of 0.1% through a temperature cycle of  $-67^{\circ}$  F. to  $+190^{\circ}$  F.

\*designed and manufactured for a specific application in aircraft glidepath equipment.

**CHICAGO MAGNETIC  
CONTROL**

1616 NORTH DAMEN AVENUE  
CHICAGO 47, ILLINOIS  
CIRCLE 111 ON READER-SERVICE CARD

## Thermostat

### Controls Two Separate Circuits



Two independent electrical circuits can be controlled simultaneously with the Series 22000 dual-control "Thermoswitch." Basically, this thermostat consists of a liquid-filled sensing element, containing a sensitive bellows-and-push-rod assembly which actuates two precision miniature snap switches mounted in the head. Each switch may be connected to operate a separate electrical circuit. This thermostat has many applications in equipment where two controls or signals are desired, and offers the advantages of simplified installation and mounting.

The thermostat can be specified to operate over one of three ranges:  $-75$  to  $+125$  F, 25 to 225 F, and 100 to 300 F. Each switch can be set in the field to actuate at any temperature within the service range. A differential setting arrangement is also available; the differential between the switches may be specified from 0 to 200 F.

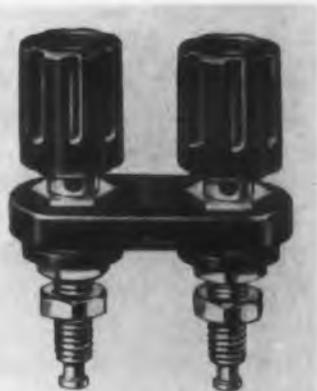
Switches are available to handle up to 20 amp at 125 v or 250 v ac, or 10 amp at 125 v dc. In addition, a choice of switches is available to provide a standard ( $\pm 1$  F) or narrow ( $\pm 0.5$  F) operating differential, and for high inrush or moisture-proof service. The sensing bulb is  $5/8$  in. diam by approximately  $3-3/4$  in. long, and is furnished either with a flange mount or a threaded fitting, depending on mounting requirements.

Fenwal, Inc., Dept. ED, Ashland, Mass.

CIRCLE 112 ON READER-SERVICE CARD FOR MORE INFORMATION

## Mounting Base

### Takes Two Binding Posts

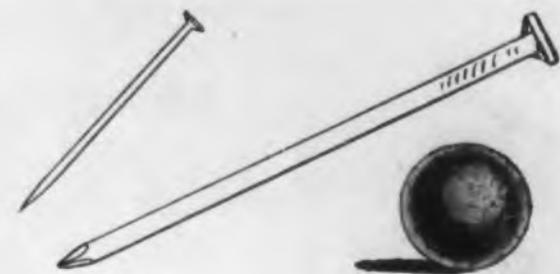


This mounting base is used for quick assembly of two binding posts to make a dual unit. It is designed to receive the Model No. 29-1 Binding Post having a OD of only  $1/2$  in., and for  $3/8$  in. mounting holes on  $3/4$  in. centers. It is available in red or black thermosetting phenolic

(MIL-P-14, type CFG). This material will withstand approximately 295 F without distortion.

Grayhill, Dept. ED, 561 Hillgrove Ave., La Grange, Ill.

CIRCLE 113 ON READER-SERVICE CARD FOR MORE INFORMATION



Some things just can't  
be improved upon



... like

## GROOV-PIN'S ORIGINAL DESIGN

Because the original design of the Groov-Pin was fundamentally perfect, they have been in use, in essentially their present form, for more than a quarter of a century. A large number of prominent American manufacturers have taken advantage of the opportunities they afford for substantial savings in manufacturing and maintenance costs, design simplification and customer satisfaction.

The Groov-Pin is a cylindrical metal pin (usually cold-rolled steel) cut from bar or coil stock. Longitudinal grooves are rolled or pressed into the body to deform the stock within controlled limits. When the Groov-Pin is forced into a hole of correct diameter, the constraining action of the wall causes the displaced material to flow back and make a locking fit within its elastic range.

Groov-Pins are assembled in straight drilled holes. No tapping, reaming, peening or milling are required. They can be driven by hand hammer, air cylinder or hydraulic press.

Send for samples and descriptive folder.  
Also manufacturers of Tap-Lok Inserts.



**GROOV-PIN CORPORATION**

1125 Hendricks Causeway

Ridgefield, New Jersey

CIRCLE 114 ON READER-SERVICE CARD FOR MORE INFORMATION

LARGE CAPACITY  
IN SMALL  
SPACE

# Fansteel TANTALUM Capacitors

The tantalum oxide film employed in Fansteel Capacitors is the most stable dielectric, chemically and electrically, yet discovered. Fansteel Tantalum Capacitors have a practically unlimited life, either in use or on the shelf; have a maximum d-c leakage of only 0.000008 ampere; and stable characteristics are unchanged over a wide temperature range.

Fansteel offers Tantalum Capacitors in 87 sizes and ratings. A partial listing is shown here. All sizes are available from stock.

Send for  
bulletin 6.100

CATALOG NUMBER	CAPACITY MFD*	WORKING VOLTAGE D-C	MAXIMUM D-C LEAKAGE †
PP30B6A1	30	6	1.0
PP25B8A1	25	8	1.0
PP20B10A1	20	10	1.0
PP15B15A1	15	15	1.5
PP10B25A1	10	25	2.0
PP8B30A1	8	30	2.0
PP5B50A1	5	50	3.0
PP4B60A1	4	60	3.0
PP3.5B75A1	3.5	75	3.0
PP2B100A1	2	100	3.0
PP1.75B125A1	1.75	125	3.0
PP140B6A1	140	6	2.0
PP100B10A1	100	10	2.0
PP70B15A1	70	15	3.0
PP40B30A1	40	30	4.0
PP25B50A1	25	50	5.0
PP20B60A1	20	60	5.0
PP15B75A1	15	75	6.0
PP11B100C1	11	100	7.0
PP9B125C1	9	125	7.0
PP325B6A1	325	6	3.0
PP250B10A1	250	10	3.0
PP175B15A1	175	15	4.0

\*—15% +20% at 120 cps, 25°C  
† Microamperes, at 25°C

**FANSTEEL METALLURGICAL CORPORATION**  
North Chicago, Illinois, U.S.A.

TANTALUM CAPACITORS... DEPENDABLE SINCE 1930

CIRCLE 116 ON READER-SERVICE CARD FOR MORE INFORMATION

## Large Screen Oscilloscope 12-Channel Multi-Trace



Model 2400 series multi-trace large screen oscilloscope utilizes a 17 in. kinescope to display simultaneously the 12 presentations of complex data waveforms.

Incorporated in this oscilloscope is a new method of electronic switching, which utilizes a switching rate of 20,000 cps, allowing a presentation of input waveforms with components of 2 kc or more. The number of traces is limited only by the physical size of the kinescope.

Each channel has its own individual controls for input, position, intensity and gain. Input circuits are balanced push-pull dc coupled, having an input sensitivity of 10 mv for 1 in. deflection.

RYCOM Instruments, Dept. ED, 9351 E. 59th St., Raytown, Mo.

CIRCLE 117 ON READER-SERVICE CARD FOR MORE INFORMATION

## Selenium Rectifiers For Magnetic Devices



Type 61-2020, a single phase full wave bridge rectifier, is designed to deliver 90v d-c at 175ma for an rms voltage input of 130v max.

The rectifier occupies only 1 x 1-13/32 x 1-1/4 in. overall volume and can be mounted with a No. 8 (0.164 in.) machine screw, through the hollow brass eyelet.

Type 61-2020 combined with types D-3575F and 60-9150 gives the design engineer a wider range of single phase full wave bridge rectifiers with output voltages of 90 v to 180 v dc at currents of 100 ma to 175 ma.

International Rectifier Corp. Dept. ED, El Segundo, Calif.

CIRCLE 118 ON READER-SERVICE CARD FOR MORE INFORMATION

Do you  
think about  
Angular  
Acceleration?

**BOEING**  
does

...and uses Statham Angular  
Accelerometers to test...



Statham unbonded strain gage liquid rotor angular accelerometers offer a simple, reliable means for the study of the rotary motion of a test body under conditions where a fixed mechanical reference is not available. For static and dynamic measurements in ranges from  $\pm 1.5$  to  $\pm 3,000$  rad/sec<sup>2</sup>, four standard models are offered.

Please request Bulletin AA2

*Statham*

LABORATORIES  
LOS ANGELES 44, CALIFORNIA

CIRCLE 119 ON READER-SERVICE CARD

## TRANSISTORIZED

# PULSE TEST EQUIPMENT

by *Navcor*



NAVCOR'S new 100A series of logic blocks are ideally suited as portable test equipment for generating variable pulse chains. Pulse generators, standardizers, delays, counters, and shift registers are among the logic functions available. All units are completely transistorized and stabilized over wide operating ranges . . . and the built-in power supply utilizes only two plug-in units. Individual units can be easily interconnected by back panel 'patch board' plugs to build-up a complete data handling system.

The NAVCOR Transi-Pulse 100A series of pulse generating and programming test equipment is in demand for all projects involving magnetic logic and switching transistor circuits up to 200 KC. In addition, the blocks can be readily adapted as integral components of industrial control systems.

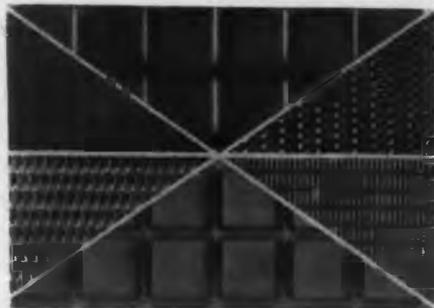
NAVCOR Transi-Pulse test equipment can help you get your transistor development project 'off the ground' — write for complete data!

NAVIGATION COMPUTER CORP.  
1621 SNYDER AVENUE  
PHILADELPHIA 45, PA.

CIRCLE 121 ON READER-SERVICE CARD

## New Metal Patterns

### Geometric Designs



Six new embossed metal patterns have been introduced. Wicker Weave (#650) is a pattern of embossed interlocking links measuring approximately three per inch, for panels, automotive interiors and exteriors, kick plates, and semi-bold application.

Chain Mail (#652) is an overall pattern of debossed grooves resembling ancient armour plate, for decorative effects on hardware, appliances, or lighting fixtures, as well as radio and TV applications.

Block (#700) and Grid (#702) are bold patterns suggesting uses on refrigerators, freezers, counter trim, and also can be furnished with perforations for speaker grilles.

Baguette (#800) is a continuous pattern of baguette-diamond shapes of jewel-like quality, for gift items and small appliances.

Roman Brick (#802) resembles continuous stacks of tiny bricks debossed into the metal and separated by a slender rib, for application where a delicate pattern is desired.

Patterns, in gages ranging from 0.012 to 0.040 in. are furnished in unfinished or in anodized, lacquered, and plated finishes.

Croroto Div., Croname, Inc., Dept. ED, 3701 N. Ravenswood Ave., Chicago 13, Ill.

CIRCLE 122 ON READER-SERVICE CARD FOR MORE INFORMATION

## Pulse Transformers

### For Special Applications



These pulse transformers, capable of high voltage and high peak power, are especially suited to military radar applications. They are constructed according to customer specifications. Also available is a line of special plate and filament transformers, if and interstage transformers for military applications, and magnetic binary transformers.

Laboratory for Electronics, Inc., Dept. ED, 75 Pitts St., Boston 14, Mass.

CIRCLE 123 ON READER-SERVICE CARD FOR MORE INFORMATION

## LARGE OUTPUT IN SMALL SPACE

# Fansteel

## HIGH-TEMP SELENIUM Rectifiers

CATALOG NUMBER	CIRCUIT	INPUT A-C VOLTS	CONT. D-C OUTPUT AT 100°C	
			VOLTS	AMPS.
TADL35L	1-35-1-H	455	402	0.004 <sup>(1)</sup>
TEUH315 <sup>(2)</sup>	2-8-1-D	132	254	0.020 <sup>(1)</sup>
TBU100L	1-100-1-H	2600	1090	0.020
TEB328L <sup>(2)</sup>	2-11-1-D	363	297	0.150
TEW066L	4-4-1-B	132	108	0.180
TEC070L	4-5-1-B	165	135	0.300
TEX034L	4-1-3-B	33	27.8	1.59
TED200LN	2-13-1-C-N	214	-175	0.600
TBY060L	4-3-1-B	78	62.7	1.0
TBY060L	4-3-1-B	41	62.7	1.0 <sup>(1)</sup>
TEEW334L <sup>(4)</sup>	2-7-1-D	231	295	2.3 <sup>(4)</sup>
TEFW332L <sup>(4)</sup>	2-13-1-D	429	548	4.6 <sup>(4)</sup>
TBG084L	2-1-1-C	13	10.4	5.2
TET050L	4-2-1-B	66	53.9	4.6
TEP314L <sup>(2)</sup>	2-7-2-D	231	189	14.0
TER020L	6-3-1-B	66	79.5	12.9 <sup>(2)</sup>
TER034L	4-1-3-B	33	27.8	25.8
TBR008L	6-1-4-B	26	32.5	51.6 <sup>(2)</sup>

<sup>(1)</sup> Capacitive Load. Ratings unmarked are for resistive or inductive loads.

<sup>(2)</sup> Hermetically Sealed.

<sup>(3)</sup> Two stacks required.

<sup>(4)</sup> Three stacks required.

<sup>(5)</sup> Resistive, inductive or capacitive load.

Operating at 100°C (212°F) Fansteel High Temperature Rectifiers deliver full rated power output, continuously, with no derating whatever. At temperatures up to 150°C (302°F), only moderate derating is necessary.

Fansteel High Temperature Rectifiers are available in all standard cell sizes and all standard circuit arrangements and with all standard protective finishes — moisture resistant, fungus resistant and a salt-spray resistant finish that meets MIL specifications. The table indicates a partial list of over 100,000 available types.

Send for  
bulletin 6.401

FANSTEEL METALLURGICAL CORPORATION  
North Chicago, Illinois, U.S.A.

DEPENDABLE RECTIFIERS SINCE 1924

CIRCLE 124 ON READER-SERVICE CARD FOR MORE INFORMATION



## New, Ultra-Miniature Model 6 1/10-Watt Variable Resistor

Resistance range, 500 ohms to 10 megohms

For applications where small size and high quality are factors . . .

Hearing aids  
Transistor radios  
Telephone equipment  
Military applications

-  Only 1/2 inch in diameter. Without switch, .127 thin. With switch, .200 thin.
-  On-off switch completely enclosed within control. Rated 2.5 amps. at 2.0 v.d.c.; 0.1 amp. at 45 v.d.c.
-  Tested to a minimum of 25,000 complete cycles. Seven standard tapers.
-  Smooth, noise-free operation.
-  Variety of mountings available.

Technical Bulletin EP-77 gives complete engineering data. Write for it.

# Centralab

A DIVISION OF GLOBE-UNION INC.

9601 East Keefe Avenue • Milwaukee 1, Wisconsin  
In Canada: 804 Mt. Pleasant Road, Toronto, Ontario



CIRCLE 126 ON READER-SERVICE CARD FOR MORE INFORMATION

## Laboratory Hygrometer

Provides Pin-Point Accuracy



Model 101 is specifically designed for professional use where pin-point accuracy is required by experimental centers, particularly those conducting environmental tests on electronic products, paints and similar items.

It provides precise measurements over a range of 10-100% relative humidity. Individual calibration of the element within the reader results in a measurement of better than 1%. This model operates from conventional ac line frequency and is compensated for line voltage variations.

EL-Tronics, Inc., Dept. ED, 1420 Walnut St., Philadelphia, Pa.

CIRCLE 127 ON READER-SERVICE CARD FOR MORE INFORMATION

## Six Channel Recorder

Used with Analog Computers



This Six Channel "REAC" Recorder, designed specifically for use with analog computers, automatically records reference data. Pen zero, attenuator setting, and electrical offset for each channel, as well as paper speed, are recorded on the chart at the start of each run. These reference data are recorded at a speed independent of the actual paper speed setting. As soon as the data are entered,

the computer and recorder are both switched automatically to "operate", and the run is thereafter recorded at the rate to which the speed switch is set. A "zero-time" marker indicates the point at which the run began.

All standard computer controls are provided on the recorder; thus the entire computer installation may be operated from the recorder. Eight paper speeds are available, ranging from 1-250 mm/sec. The paper table is horizontal, and placed at convenient writing height. Frequency response is uniform to 60 cps. Full scale voltage ranges from  $\pm 1$  v to  $\pm 200$  v, with eight attenuator settings, provide voltage control between the ranges of 0.05 to 10 v/mm.

Reeves Instrument Corp., Commercial Products Div., Dept. ED, 215 E. 91st St., New York 18, N.Y.

CIRCLE 128 ON READER-SERVICE CARD FOR MORE INFORMATION

## Designed for Dependability in Transistor Circuits



### NEW MALLORY MERCURY BATTERIES

Unique snap-together cell design brings new economy to Mallory Mercury Batteries—provides long life and constant discharge features at operating costs even lower than ordinary batteries. Triples usual life expectancy in transistor radios. Miniature 15, 22.5 and 45 volt batteries now available as well as special voltages and configurations.

### MALLORY SUBMINIATURE CAPACITORS

Newly developed Type TNT tantalum capacitors . . . another Mallory "first" . . . offer ratings never before possible in a case only 0.145" in diameter by 3/8" long. Five different values: 80 mfd. at 3 volts; 50 mfd. at 6 volts; 25 mfd. at 15 volts; 15 mfd. at 30 volts; and 8 mfd. at 50 volts.

For technical facts, write to

P. R. MALLORY & CO. INC.

Indianapolis 6, Indiana

®Trade Mark

†Patent applied for

# MALLORY

CIRCLE 129 ON READER-SERVICE CARD

## Vibration Exciter

### For Environmental Test Chambers



The Model C25HB is an oil-cooled electro-dynamic vibration exciter designed specifically for environmental test chambers. It has high performance ratings, also useful in normal atmosphere testing. The exciter may be operated continuously at its full rated sinusoidal force output of 3500 lb or 5000 lb (depending on the power supply and as limited by displacement), and equivalent acceleration in a frequency range from 5 to 2000 cps at chamber altitudes from 0 to 125,000 ft, relative humidities from 0 to 95%, and temperatures between -100 and +300 F.

The exciter may be rotated 90° on its trunnion and operated in any position from vertical to horizontal. The specimen table is a flat, circular surface, which simplifies the installation of a temperature and humidity shield in conjunction with a hood for chambers with limited cooling capacities. The exciter can be mounted on a special motorized dolly, which may be rolled in and out of the chamber. The dolly has jacks to raise the exciter and to lower it on neoprene "Isomode" units.

The exciter is used with electronic or rotary power supplies and either manual or automatic control systems.

MB Manufacturing Co., Dept. ED, 1060 State St., New Haven, Conn.

CIRCLE 132 ON READER-SERVICE CARD FOR MORE INFORMATION

## Gain and Phase Analyzer

### For Color TV Measurements



The type 2036, a differential gain and phase analyzer, is intended primarily for measuring the transmission characteristics of color TV networks. It is designed for use with any standard stair-step generator having a 3.58-Mc sub-carrier. It features a high impedance input, extremely high sensitivity, and low noise, together with a unique differential gain presentation. A precise, continuously variable, 360° phase shifter makes the Type 2036 particularly suitable for color signal certification and large differential phase measurements.

Tel Instrument Electronics Corp., Dept. ED, 704 Garden St., Carlstadt, N.J.

CIRCLE 133 ON READER-SERVICE CARD FOR MORE INFORMATION

## NEW TRANSFORMER DEVELOPMENTS ...

# Westmold and Westseal types resist moisture and heat

**NEW WESTMOLD TRANSFORMERS—** offer exclusive dimensional fidelity, flame resistance and greatest resistance to moisture penetration ever available in an open-type transformer (where MIL-T-27 grades 2 and 5 are required). This new type is molded in a plastic material which maintains its flexibility at extreme temperatures. Will withstand shock of being heated to 130°C, then plunged into -55°C alcohol-dry-ice. Ten of these cycles are passed without cracking, complying with Type C thermal shock test, MIL-C-16923. Dimensional fidelity is assured as the shape of the transformer is fixed by the mold in which it is poured.

**NEW WESTSEAL TRANSFORMERS—** Small, lightweight power transformers and filter chokes have been developed for radar, airborne electronics and other applications demanding good resistance to humidity and high temperatures (where MIL-T-27 grades 2 and 5 are required). They are impregnated with a newly developed solventless silicone resin and sealed with an impervious coating of silicone rubber.

The compound is firmly bonded to the transformers and to the terminals, eliminating any "wick" action. Coils are completely filled, free of voids. Result—corona-free operation in the 5000-volt range.

For further details, circle the proper number on the Reader-Service Card, see your Westinghouse Sales Engineer or write to Westinghouse Electric Corporation, Specialty Transformer Division, P. O. Box 231, Greenville, Pa. J-70772

## WATCH WESTINGHOUSE!

COVER THE PRESIDENTIAL CAMPAIGN ON CBS TV AND RADIO!

### WESTMOLD



### WESTSEAL



CIRCLE 134 ON READER-SERVICE CARD FOR MORE INFORMATION

**HYCOR**  
*Miniature*  
**MAGNETIC CLUTCHES**



## Only 1 watt of power required ...

to develop 15 oz. in. of torque with a response time of 5 milliseconds. Only two moving parts which eliminate all maintenance problems.

Minimum dimensions (only 1" o.d.) facilitate their use in compact assemblies. Extremely low cost enables designers to utilize the benefits of multiple clutching in inexpensive electronic equipment.

Send for Bulletin C-1 for complete details

*Hycor's systems engineers will be pleased to assist in special design applications.*

Representatives in principal cities

**HYCOR**

DIVISION OF INTERNATIONAL RESISTANCE COMPANY

12970 Bradley Avenue, Sylmar 4, Calif.

CIRCLE 131 ON READER-SERVICE CARD

**Signals can get crossed-up here**



**...but your relays have to be right every time in this league!**



Elgin's New NEOMITE . . . the world's smallest, weighs only .09 ounces . . . yet resists vibration up to 500 cps. at 10 G over a -55°C to +85°C temperature range and has a contact rating of 28 v DC at 250 ma. Resistive Load. Write today for complete specifications.



## ELECTRONICS DIVISION

ELGIN NATIONAL WATCH COMPANY  
Elgin, Illinois

Sales Representatives in Principal Cities of U. S. and Canada

CIRCLE 136 ON READER-SERVICE CARD FOR MORE INFORMATION

### Rotary Solenoids New Small Model Added



The smallest of eight basic sizes, the Model BD1E rotary solenoid weighs 1-1/2 oz and has a diameter of 1 in. Starting torques for the entire line now range from 0.2 lb-in. for the new size to 54 lb-in., based on ampere-turns for normally intermittent duty cycle and rotary stroke of 45 deg.

Standard rotary strokes for the BD1E are 25, 35, and 45 deg, either clockwise or counterclockwise. Voltage requirements of 2-200 v dc can be accommodated with coil wire gages ranging from No. 25 to No. 40.

All eight models employ the same principal of operation. The magnetic pull moves an armature along the solenoid axis, and this linear action is efficiently converted into rotary motion by ball bearings on inclined races. The resulting snap-action power can be harnessed with a minimum of linkages.

G. H. Leland, Inc., Dept. ED, 123 Webster St., Dayton, Ohio.

CIRCLE 137 ON READER-SERVICE CARD FOR MORE INFORMATION

### DC Tachometer Generators

Weigh Approximately 3 oz

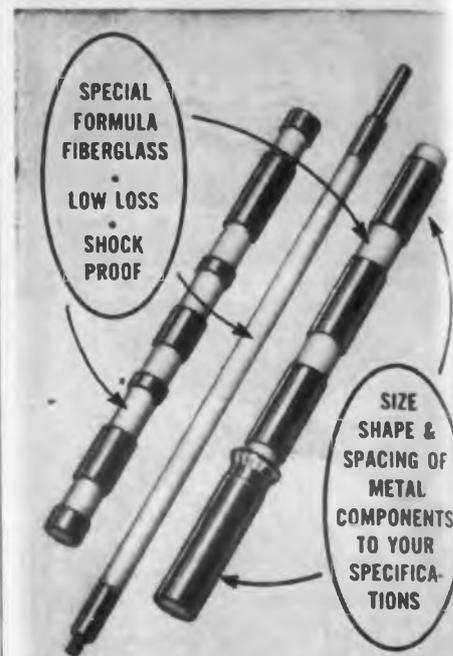


A line of low cost dc tachometer generators is offered with diameter of 1 1/8 in. and weight slightly more than 3 oz. Although used principally as rate generators in servo systems, these units have many other uses. When combined with a standard 1000 ohms/v voltmeter, they make an excellent direct-reading tachometer. They can be used as under or over speed indicators, speed synchronizing controls, and for numerous other applications.

Output voltage is proportional to speed better than 1/2%, with ripple well under 3%. Various models are available with output voltages as high as 15 v per 1000 rpm. Output voltage for either direction of rotation is held to a tolerance of better than 1/4%. Various mounting arrangements are provided, and a choice of models is ready for immediate delivery from stock.

Servo-Tek Products Co., Inc., Dept. ED, 1068 Goffle Rd., Hawthorne, N.J.

CIRCLE 138 ON READER-SERVICE CARD FOR MORE INFORMATION



**STOP BREAKAGE!**  
Get Automatic's New  
**"HIGH-STRENGTH"** Rotor  
Shafts, Plunger Rods  
& Connecting Rods!

Stop worrying about the breakage problem of ceramics and steatite. Automatic's "Hi-Strength" rods and shafts are the revolutionary answer to the problem of transmitting mechanical motion to electrical components without electrical loss.

#### SHOCK PROOF . . .

"Hi-Strength" rods have 5 times the tensile, 4 times the flexural and 12 times the impact strength of steatite.

#### LOW LOSS . . .

Special formula fiberglass insures excellent electrical characteristics under most operating conditions.

Compare the physical and electrical properties of Automatic's "Hi-Strength" with steatite as tested and certified by the United States Testing Laboratories, then specify . . . "Hi-Strength."

WRITE, WIRE OR PHONE FOR FURTHER INFORMATION AND TECHNICAL DATA.

**Automatic**

METAL PRODUCTS CORP.

319 Berry Street, Brooklyn 11, N.Y. • EVergreen 8-0364

CIRCLE 139 ON READER-SERVICE CARD

An Engineer  
Speaks Out...



### ...about a Servosystem Analyzer

Seems to me that a really good servosystem analyzer must fill two important requirements. First, it must give an engineer more accurate and faster results than a home rig. And secondly, it must be able to quickly test a variety of equipment and systems.

We produce a servosystem analyzer at Servo Corp.—the Servoscope®—which meets these requirements.

The Servoscope gives you faster, more accurate results because it provides a *direct* method for measuring gain and phase shifts of any component or system in the lower frequency ranges. There's nothing complicated about using it. Just by turning the big dial, you get phase lead or lag. Signal amplitude is read directly from the associated indicator.

Servoscope is an extremely versatile test instrument. Its applications include: automatic flight and ship control design, testing computer response, checking vibration, testing response of servosystems and fire control systems.

If you'd like additional information on the Servoscope and its use, please fill out your name and title in the space below. Attach it to your company letterhead and mail it to me.

*Tom Westover*  
Chief Control Systems Engineer



Electro-  
mechanical  
Control Systems  
and Components  
for Industry by

**SERVO**  
CORPORATION  
OF AMERICA

Tom Westover, Dept. W-14  
Servo Corporation of America  
20-20 Jericho Tpke., New Hyde Park, L.I., N.Y.  
Please send me more information on  
Servoscope.

Name.....  
Title.....

CIRCLE 141 ON READER-SERVICE CARD

### Frequency Indicator

Counts up to 9999 Events/Sec



Model 7340A Frequency Indicator and Counter is offered for counting and recurrence rate measurement of mechanical and electrical events. The instrument is valuable for such applications as rpm measurement, oscillator calibration, direct counting, and flow measurement.

Counting and indication with automatic decimal point location are easily read from glow transfer tubes directly in events per second ranging from 1 to 9999 events. A precision synchronous motor establishes the gate time (from 1 sec to 10 sec) during which input events are counted. For gate times longer than 10 sec or for cases where a straight counter is desired a manual gate switch is provided. For applications requiring a permanent record of readings, the instrument can be delivered as the Model 7341A (illustrated) with outputs for driving a serial type print-out.

Electro-Pulse, Inc., Dept. ED, 11861 Teale St., Culver City, Calif.

CIRCLE 142 ON READER-SERVICE CARD FOR MORE INFORMATION

### Transistorized Servo Amplifier

Hermetically-Sealed, Plug-In Type



Primarily intended to receive signals from a synchro control transformer, and to operate a size 15, 400 cycle, 6.1 w servo motor or equivalent, this new servo amplifier is designed to meet the environmental

requirements of Specification MIL-E-5400.

Physical properties are: 1-3/16 x 1-11/16 x 3-13/16 in. high; 6 oz; flat black finish; 7-pin plug-in, hermetically sealed connector; three 6-32 weld mounting studs. Electrical properties: 10,000 ohms input impedance (also available in other ranges); typical voltage gain of 750 at 3.5 w output, 200 at 6 w output; internally adjusted phase shift to provide essentially zero phase shift; 380 to 420 cps carrier frequency; 40 v rms max output (6.1 w) at 400 cps when used with Kearfott Type R110-5 Servo Motor; torque at this voltage is 1.45 oz-in.; 28 v dc at 300 ma.

M. Ten Bosch, Inc., Dept. ED, Pleasantville, N.Y.

CIRCLE 143 ON READER-SERVICE CARD FOR MORE INFORMATION



**ALL Eimac Air  
System Sockets are  
Thermo-Electrically  
Designed for  
Optimum Cooling**

To perform a specific function in a specific manner calls for custom design. To cool a tube efficiently, keeping airflow and circuit losses at a minimum, calls for a thermo-electrically designed air socket.

Eimac's line of 16 air sockets provides these advantages for nearly all Eimac multi-grid and klystron tube types.

Pictured above is the SK-100, for the 3K3000L-series klystrons. Below it the SK-400, for the 4-400A. Next is the SK-600, for the 4X250B. And finally the SK-300, for the 4X5000A. Each is the best for its own specific function. And each is an original Eimac custom design. There are 12 others, every one as outstanding.

Among these 12 is the SK-630. Developed for use with Eimac's 4X150A, 4X150D, 4X250B, 4X250F, and 4W300B in tropical atmospheres, it employs an encapsulated screen-to-cathode bypass capacitor which, in combination with shielded circuits, permits stable high gain operation up to the tube's highest useful frequency.

Eimac air system sockets chimneys are also available.

For further information, write  
our Application Engineering Department.

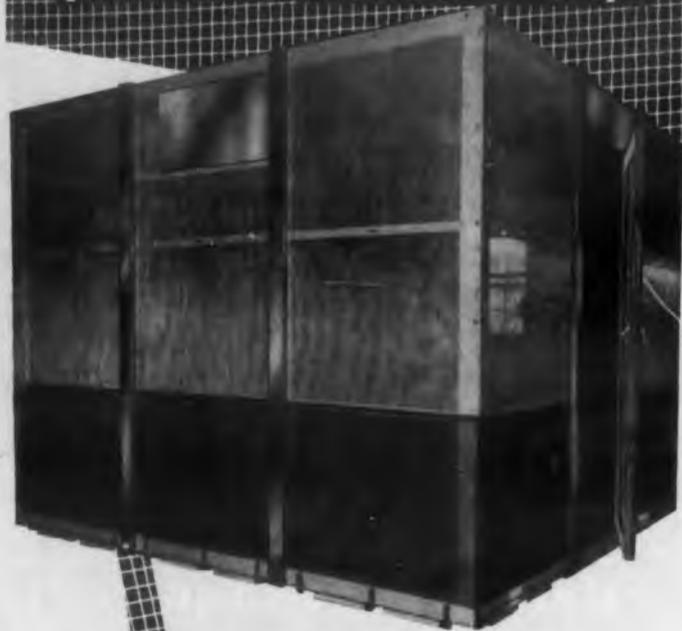
*Eimac*

**EITEL-McCULLOUGH, INC.**  
SAN BRUNO CALIFORNIA  
The World's Largest Manufacturer of Transmitting Tubes

CIRCLE 144 ON READER-SERVICE CARD FOR MORE INFORMATION

New! **LINDGREN**  
"Superior"  
**SCREEN ROOM**  
PATENT PENDING

\$ for \$—feature for feature,  
your best attenuation buy!



**PERFORMANCE EXCEEDING  
REQUIREMENTS IN MIL-16910,  
MIL-S-4957, JAN 1-225.**

manufacturers  
of the

**ORIGINAL,  
ISOLATED**

**40' demount-  
able section**

**SHIELDED  
ENCLOSURES**

- Attenuation of Lindgren true double shielded enclosures is highest on market, 146 db—copper, 128 db—bronze.
- One inch plywood flooring with vinylite covering (1,500 lb. per sq. ft.).
- New door with single, extra-heavy brass handle—3 point pressure contact, 3 ball bearing hinges. Door has 36" actual opening—door jamb covered with 20 gauge, 24 oz. copper.
- Double row of heavy-duty 3/4" contact fingers on door.
- Expanded metal kick plates.
- Portable—easy to assemble—easy to take apart for storage or location changes.

**NEW ROTO-LOCK**

Draws panels together at pressure of 1,200 lbs., creates air-tight seal. Also locks in any semi-open position. No springs or other delicate mechanical parts. ROTO-LOCK completely recesses into screen room panels—leaves no exposed parts—prevents damage—improves appearance.

Reg. U.S. Pat. Off.

Write Today for Complete Details,  
Specifications & Performance Charts.



**ERIK A. Lindgren & ASSOCIATES, Inc.**  
4515-17 N. Ravenswood Ave., Dept., ED-9, Chicago 40, Ill.  
Longbeach 1-0408

CIRCLE 146 ON READER-SERVICE CARD FOR MORE INFORMATION

**Leak Detector**

Tests Pressure and Vacuum



This portable leak detector is capable of exacting tests of either evacuated or pressurized systems. Known as Type 24-210, it can be used to show the existence or absence

of extremely minute leaks, to determine the rate of leakage, and to pinpoint the exact location of a leak. The instrument is a simplified mass spectrometer which responds only to the presence of helium as a tracer gas. By probe or air-sampling methods, it will detect one part of helium in 300,000 parts of air.

Applications include testing hermetically sealed parts, refrigeration units, high-vacuum systems, drums and other containers, or any other product which depends on a perfect seal. A 145-lb unit, it is 20-1/2 in. high and requires a table area of only 18-1/2 x 22 in. It operates on 105/125 v ac.

Consolidated Electrodynamics Corp., Dept. ED,  
300 N. Sierra Madre Villa, Pasadena, Calif.

CIRCLE 147 ON READER-SERVICE CARD FOR MORE INFORMATION

**Corona Tests**

May Be Repeated Frequently

A self-contained and non-destructive Corona Test Set, which enables simple and accurate corona testing for research, development or production requirements, includes all the necessary circuit refinements and controls to permit a continuous and adjustable output. An overload relay protects the specimen and the power unit in the event of a short circuit. Accurate voltage indication is provided for with a triple range kilovoltmeter at the output terminals. Special sweep circuits provide a straight line oscilloscope trace with recurring corona pulses occupying the center of the trace. The presence of noise will not detract from the clear presentation of these pulses. The set can be equipped with a motorized output control to enable the gradual application of test voltage at uniform rates of 500 or 1000 v per second.

The Peschel Set meets ASTM, MIL, JAN and IPCEA specifications. Standard sets are available from small portable units to very large sets of up to 100 kva capacity and in voltages up to 30 kv. Special units can be manufactured with voltages up to 80 kv.

Peschel Electronics Inc., Dept. ED, 15 Garden St., New Rochelle, N.Y.

CIRCLE 148 ON READER-SERVICE CARD FOR MORE INFORMATION

lower costs...  
improve design...  
save time...  
with  
**GRC die cast  
GEARS & PINIONS**

Cast in one piece, at one time—and one low unit cost! Produced precisely to your specifications, permitting a wide flexibility of design. One-piece assemblies can be cast with shafts or center holes, or in combination with cams, hubs, spacers, flanges. Maximum size: 1-5/16" outside diameter x 1/16" face width; wider faces for smaller diameters. **MANY COMBINATIONS AVAILABLE FOR LESS PRECISE APPLICATIONS FROM STOCK DIES AT NO TOOLING CHARGE.**

COMBINATIONS  
die cast in  
**ONE**  
piece!

Write today for Full Information and Samples

Send specifications for prompt quotation 100,000 to millions  
World's Foremost Producer of Small Die Castings.



**GRIES REPRODUCER CORP.**

40 Second St., New Rochelle, N. Y., New Rochelle 3-8600



CIRCLE 149 ON READER-SERVICE CARD FOR MORE INFORMATION



NO TYING! NO DIPPING!

**new  
Varband  
BONDING  
TAPE**

Bonds and Protects Wires  
PERMANENTLY!

**Resists OIL, GREASE, VIBRATION,  
ACID, VAPOR, HEAT and PRESSURE**

Nothing cracks the bond between new Varband Bonding Tape and the wires it holds or encases. That's because Varband Tape is composed of hundreds of parallel strands of Fiberglas which are twisted and impregnated with a special polyester resin. You simply wind Varband Bonding Tape around wires as you would ordinary tape. Soldering iron heat-seals ends without tying. Then cure (recommended curing is 3 hours at 125° C or less time at higher temperature) . . . and Varband becomes a homogeneous machinable mass that is impregnated not just on the surface . . . but all the way through.

**MANY OUTSTANDING  
PROPERTIES**

High Tensile Strength  
High Mechanical Strength  
High Impact Strength  
High Dielectric Strength  
No Interference with  
Magnetic Field  
No Arc-Over Danger  
High Thermal Stability  
Varband Bonding Tape is pre-treated, eliminating separate dipping operation. Steel banding wire and metal shields are no longer necessary. Provides valuable savings! Reduces weight!



**THOUSANDS OF INDUSTRIAL APPLICATIONS.** Armature banding, core winding, coil supports and stator windings are but a few of Varband's thousands of industrial applications. Particularly ideal for anchoring wires in vibrating power tools or any wire assemblies that rotate at high speeds. **EXAMINE A SAMPLE TODAY!** Available in 6 widths, .015" to .030" thick — Varband can also be designed to meet your requirements.

**VARFLEX CORPORATION, 514 W. COURT STREET, ROME, N. Y.**

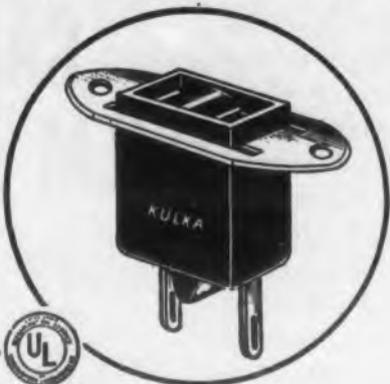
CIRCLE 150 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Miniature POWER OUTLETS

For Small Electrical and Electronic Units

SHOWN FULL SIZE

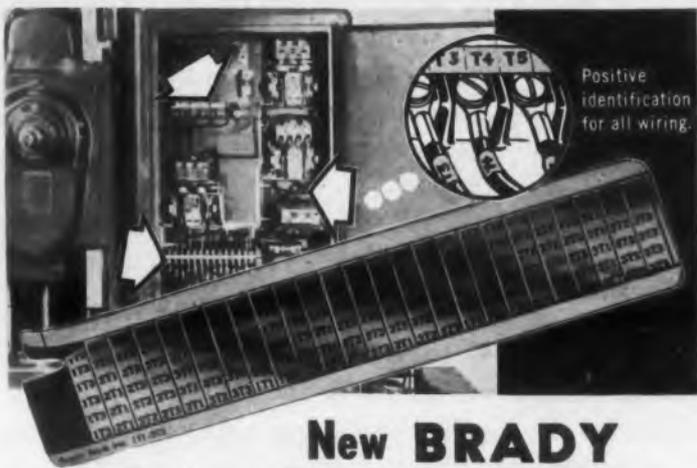
- SMALLEST MADE
  - TAKE STANDARD PLUG
  - MOUNT FROM TOP OR BOTTOM OF FLAT BRACKET
  - CHOICE PRE-WIRED STYLE, OR WITH SOLDERING TERMINALS
  - PHENOLIC BLOCK HAS BARRIER TO PREVENT SHORTS
- AC and DC



No. 221 (above) with soldering terminals and steel bracket with #6 clearance mounting holes. Also No. 222 with 6-32 tapped mounting holes. No. 223 (left) with 8" #14 or #16 plastic wire leads and steel bracket with #6 clearance mounting holes. Also No. 224 with 6-32 tapped mounting holes.

**KULKA ELECTRIC MFG. CO., Inc.**  
Manufacturers of Electrical Wiring Devices  
MOUNT VERNON, N. Y.

CIRCLE 152 ON READER-SERVICE CARD FOR MORE INFORMATION



## New BRADY Aluminum Foil Wire Markers

-Give Permanent Identification

Stick and stay in elevated temperatures, oils, most solvents

New Brady Aluminum Foil Wire Markers show which wire goes where at a glance. Permanently identify machine tool electrical systems, motor leads, control circuits, etc.

Only 3 mils thin. Self-Sticking Markers wrap around

wire fast. Legends imbedded in the foil stay permanently legible. Markers stay on wire under oily conditions — won't discolor at temperatures to 350°F.

NEMA and NMTBA Markers in stock for immediate delivery. Specials made to your order. Write today for free working samples, prices, and name of local distributor

W. H. **BRADY** CO.  
Est. 1914

783 W. Glendale Ave.  
Milwaukee 9, Wis.

CIRCLE 153 ON READER-SERVICE CARD FOR MORE INFORMATION

## Nylon Tubing

Withstands High Temperature



This large diameter thin-wall "Zytel" nylon tubing is for use in the electronic, chemical, and processing industries. Chemical resistance,

flexibility, high burst strength, and the good dielectric properties of the tubing make it valuable for handling of liquids and for use as an electrical insulating medium. The material can be held to a close tolerance and is easily joined together to custom fit job requirements.

The tubing is insoluble in common solvents, alkalis, dilute mineral acids, and most organic acids. Unlike most thermoplastics, it does not soften gradually as the temperature is raised. It has a relatively sharp melting point and it loses little of its many properties at temperatures below 300 F; when subjected to load, service temperature should not exceed 275 F.

Keystone Plastics, Inc., Dept. ED, 2331 Morris Ave., Union, N.J.

CIRCLE 154 ON READER-SERVICE CARD FOR MORE INFORMATION

## Time Delay Relay

Permits Electrical Interlock



A time delay relay which allows electrical interlock and two step timing, the Model NETL "Agastat" is a combination unit with two normally closed microswitches and a basic "Agastat" relay.

Contacts of the micro-switch are on the front side of the relay and are held in the open position by a lever before energization. Upon energization of the relay coil, the contacts close instantly, locking in the circuit. The two step timing action then takes place. A second microswitch attached to the bottom of the relay provides the two step timing; the switch has a cam adjustment that varies the timing between the two steps. This is in addition to the timing adjustment on the basic unit.

The relay is made with dial head adjustment. It is available for ac or dc, intermittent or continuous duty, in spdt double-break, and dpdt single-break models. It is rated 15 amp at 115 v 60 cps.

A'G'a Div., Elastic Stop Nut Corp. of America, Dept. ED, Elizabeth, N.J.

CIRCLE 155 ON READER-SERVICE CARD FOR MORE INFORMATION

PANEL SPACE LIMITED? SPECIFY

**DIALCO** 2-Terminal

## Sub-Miniature Pilot Lights

COMPACT  
RUGGED

OMNIDIRECTIONAL  
PLASTIC DOMES

COMPLETELY  
INSULATED

Also available with "Taper-Tab" quick-connect terminals

BACK of panel insertion

OR FRONT of panel insertion



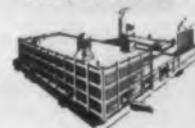
△ Dimming and  
◁ Non-dimming types

Also  
**1-Terminal Pilot Lights**  
for use on grounded circuits. Available with binding screw or soldering terminal.

DIALCO's expanded line of sub-miniature lights conform to all applicable Mil Specs. Use T-1 3/4 midget incandescent lamps—1.3 to 28 V. Spring mounted *Lens-with-Message* is readily positioned after installation... Mount from back of panel in 15/32" clearance hole; or from front of panel in 17/32" hole... 7 lens colors... Shown approx. actual size (top to bottom): No. 134-3830-375-6... No. 101-3830-951... No. 101-5030-951... No. 109-3830-111... No. 111-3830-111... No. 107-1930-951.

Complete details in Brochures L-156 A and L-157.

SAMPLES ON REQUEST—AT ONCE—NO CHARGE



Foremost Manufacturer of Pilot Lights  
**DIALLIGHT**  
CORPORATION

46 STEWART AVE., BROOKLYN 37, N. Y. • HYacinth 7-7600

DIALIGHT CORP., 46 Stewart Ave., Brooklyn 37, N. Y.

Send brochures on Sub-Miniatures  Selection Brochure  Pilot Light Catalogues

Name \_\_\_\_\_ Position \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

CIRCLE 156 ON READER-SERVICE CARD FOR MORE INFORMATION



# New

## X-500 Sub-Miniature ACEPOT\* rated to 150° C.

ACEPOT\* - ACETRIM\* sub-miniature, precision wire-wound potentiometers and trimmers are shocking to new highs!

X-500 "Hotpot" operates from -55° C. to 150° C. 1/2" size up to 250K ± .3% linearity proved in use

ACEPOTS and ACETRIMS meet unusually rigid functional and physical requirements and are setting new standards for dependability in sub-miniaturization. The designs are the result of 4 years' development and over a year of successful use by leading electronic and aircraft equipment manufacturers.

### Condensed Engineering Data

	ACEPOT (potentiometer)	ACETRIM (trimmer)
Resistance Range	200 $\sim$ to 250K $\pm$ 2%	10 $\sim$ to 150K $\pm$ 3%
Size	1/2 x 1/2"	1/2 x 1/2"
Linearity	$\pm$ .3%	$\pm$ 3%
Resolution	extremely high	excellent
Ambient Temperature	-55° C to 150° C	-55° C to 125° C
Torque	low or high	low or high

The above specifications are standard — other values on special order. All units sealed, moistureproofed, and anti-fungus treated. Meet applicable portions of JAN specs and MIL-E-5272A standards.

Ace also offers larger size precision potentiometers, to RETMA specifications, manufactured to highest standards to meet your most rigid requirements. Expedited delivery from special order section.



For applications where you must be positive, answer your potentiometer and trimmer needs with space and weight saving, highly accurate and dependable ACEPOTS and ACETRIMS.



Available in threaded bushing, servo, flush tapped hole or flange mounts, and ganged units. Special shaft lock is self-contained. Internal stops and taps as required. Indexing pin provides non-rotational mounting.

Expedited delivery on prototypes; prompt servicing of production orders. Write for Fact File and application data sheets.

\*trademarks applied for

ACEPOT\*  
ACETRIM\*

**ACE ELECTRONICS ASSOCIATES**

Dept. ED 101 Dover St. • Somerville 44, Massachusetts

See the Newest and latest at the National Electronics Conference—BOOTH 444

CIRCLE 158 ON READER-SERVICE CARD FOR MORE INFORMATION

### Analyzer

For Capacitors and Resistors



The Model CRA-2, a capacitor-resistor analyzer, is for use in industrial and military electronics, black and white and color TV, and all related fields. A

vacuum tube ohmmeter circuit displays accurate insulation-resistance values on the meter for many types of capacitors. The extended range calibrated power factor control permits power factor measurements of electrolytic capacitors rated low as 6 v and as high as 600 v dc. This special "Quick Check" circuit performs rapid "in circuit" tests for shot, open, intermittent high rf impedance, and high power factor without removing or disconnecting the component from its operating circuit.

When making leakage current measurements with the instrument, the values are read directly from the meter while the rated operating voltage is applied to the capacitor.

Pyramid Electric Co., Dept. ED, 1445 Hudson Blvd., North Bergen, N.J.

CIRCLE 159 ON READER-SERVICE CARD FOR MORE INFORMATION

### Precision Potentiometers

Have up to 74 Taps



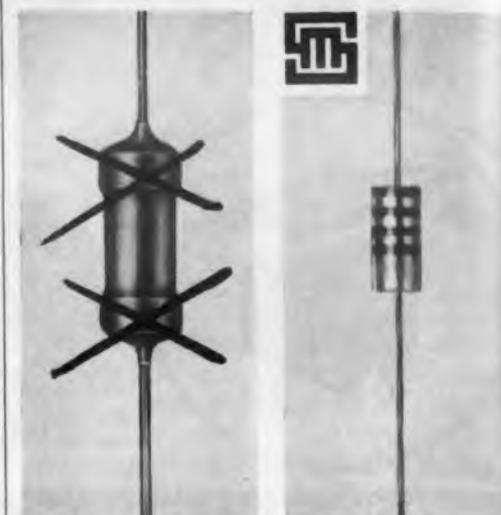
The terminal and tap design (patent applied for) of the RL-270A series of precision potentiometers makes it possible to provide large numbers of taps without affecting performance. Positive precious-metal spring contacts with extremely high unit pressures ensure permanent vibration-proof contact having low resistance without linearity distortion at the tap. The RL-270A series is available with up to 74 taps in the 5 in. model, 40 taps in the 3 in., 26 taps in the 2 in., 20 taps in the 1-5/8 in., and 14 taps in the 1-1/4 in. size.

The 5 in. diam unit shown has 48 taps around the perimeter, spaced to give 47 equal resistance sections, while maintaining the guaranteed linearity of  $\pm$ 0.1%. There is a total resistance of 500,000 ohms, which affords a resolution of 0.0075% (13,000 turns).

Precision Potentiometer Div., The Gamewell Co., Dept. ED, Newton Upper Falls 64, Mass.

CIRCLE 160 ON READER-SERVICE CARD FOR MORE INFORMATION

## STEMAG PRESENTS THE FIRST CAPLESS\* FILM RESISTOR



1w Regular Carbon Film Resistor with end caps. 1w patented STEMAG Film Resistor without end caps.

Now you can obtain long life stability of carbon film resistors with small size and low price of carbon composition types. Available in the same wattage ratings, dimensions, tolerances and color code as carbon composition type resistors.

### NOTE THESE FEATURES:

- Derating: 75° C. (1/2 w type)
- Load-Life Test: MIL-R-11A max. change 1.3%
- TC: 200 to 400 PPM per °C
- Lead Connection: Direct capless contact inside resistor body
- Noise Level: Extremely low. No noise generating end caps
- Tolerances:  $\pm$  5 % and  $\pm$  10 %
- Sizes: 1/2, 1, 2 watt

\*U. S. Pat. 2658980

For complete specifications and test data write to:

**Arnhold CERAMICS, INC.**

1 East 57th St., New York 22, N. Y.

CIRCLE 161 ON READER-SERVICE CARD

# Transitron

## SILICON DIODES

### HIGH CONDUCTANCE

Type	RATINGS AT 150° C		
	Maximum Average Forward Current ma	Continuous Inverse Operating Voltage Volts D.C.	Minimum Saturation Voltage Volts
IN484B	50	130	150
IN486A	50	225	250
IN488A	50	380	420
IN457	25	60	70
IN458	25	120	135
IN459	25	180	180

### HIGH FREQUENCY

Type	SPECIFICATIONS AT 125° C		
	Forward Current At + 1 V ma	Inverse Current At Specified Voltage ua at Volts	Maximum Operating Voltage Volts D.C.
IN252	10	10 @ - 5	20
IN251	5	10 @ - 10	30
S9G	2	10 @ - 20	40

Typical Shunt Capacitance: 0.8 uufd  
Typical Pulse Recovery time: 0.15 usec  
Operating Frequency Range: 0-1000 mc

Write for Bulletin TE-1350

### Line of Test Equipment

#### Wired Units at "Kit Prices"

Latest additions to the test equipment line are the LSG-10 Signal Generator, the LC-4 Capacitance Resistance Tester with "in set quick check" feature, and the LC-15 Capacitance-Resistance Checker.

The LSG-10 Signal Generator has a frequency range of 120 kc to 260 mc, up to 130 mc in fundamentals.

The LC-4 C.R. Tester has four direct reading scales from 0.00001 to 1000 mfd, two resistance ranges from 100 ohms to 5 megohms, and uses magic eye as a null detector.

The LC-15 Capacitance Resistance-Checker checks for open shorts, leakage, and intermittants, in ranges from 0.00001 to 1000 mfd, and from 100 to 5 megohms.

Lafayette Radio, Dept. ED, 100 Sixth Ave., New York 13, N. Y.

CIRCLE 163 ON READER-SERVICE CARD

### Teflon Lead Wire

#### Precision Components

Capable of continuous operation up to 500 F, teflon lead wire remains extremely stable, in that it does not give off corrosive vapors when subjected to various adverse conditions such as: corrosive solvents and chemicals, sunlight, high temperatures, etc.

Available in 12 to 32 awg, in solid or spiral striped color codings, Hitemp lead wire meets MIL-W-16878 type E and EE specifications.

Hitemp Wires, Inc., Dept. ED, Mineola, N. Y.

CIRCLE 164 ON READER-SERVICE CARD

### Military Environmental Testing

#### New Facility

A new environmental testing facility is available for conducting tests in accordance with MIL-E-5272A, military environmental test specification.

Facilities are complete for functionally testing electronic, fuel, hydraulic and mechanical components and systems while these equipments are undergoing environmental qualification of reliability tests.

Parameters Inc., Dept. ED, 195 Hericks Road., New Hyde Park, N. Y.

CIRCLE 165 ON READER-SERVICE CARD

CIRCLE 166 ON READER-SERVICE CARD

## SILICON RECTIFIERS

### UP TO 35 AMPS AT 150° C

Type	RATINGS AT 150° C		
	Maximum Average Forward Current Amps	Peak Recurrent Inverse Voltage Volts	RMS Inverse Voltage Volts
Miniature (Pig Tail Leads)			
TJ10A	0.2	100	70
TJ20A	0.2	200	140
TJ40A	0.2	400	280
Military Types			
IN253*	1.0	100	70
IN254*	0.4	200	140
IN255*	0.4	400	280
IN256*	0.2	600	420
Medium Power Types			
IN249A	20	100	70
IN250A	20	200	140
TR352	20	350	250
High Power Types			
IN412A	35	100	70
IN413A	35	200	140
TT352	35	350	250

\* JAN types Rated at 135° C

Write for Bulletin TE-1351

**THE PROVEN PERFORMANCE** of Transitron's silicon rectifiers and diodes has led to their widespread use in critical high temperature applications. The large number of types available allows optimum design for any given circuit.

For low level power supply or magnetic amplifier service, the subminiature diodes or miniature rectifiers are recommended. For higher power requirements, the stud-mounted rectifiers provide up to 30 KW.

WESCON SHOW  
BOOTH 903

# Transitron

electronic corporation • melrose 76, massachusetts

Germanium Diodes

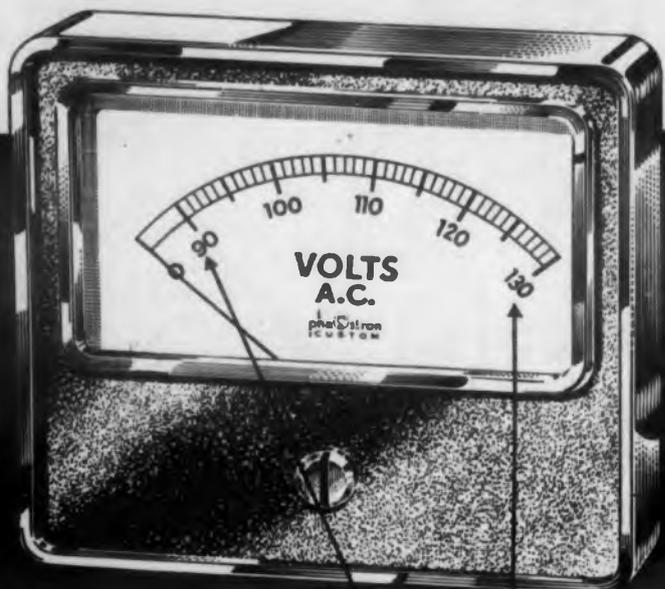
Transistors

Silicon Diodes

Silicon Rectifiers

T

# NEW PHAOSTRON EXPANDED SCALE AC Voltmeter



Available now from distributors in 90V to 130V Range. AC Rectifier Type in all custom styles and sizes.

3 1/2" and 4 1/2" rectangular meter



2 1/2" or 3 1/2" square meter



6" rectangular meter



2 1/2" or 3 1/2" round meter

Phaestron Custom Panel Meters, with expanded scale, 90V to 130V AC rms, are available in nine types at your Parts Distributor. For special requirements, write to the Product Development Department for practical recommendations.

## PHAOSTRON

PHAOSTRON INSTRUMENT & ELECTRONIC CO., 151 PASADENA AVE., SOUTH PASADENA, CALIF.

CIRCLE 167 ON READER-SERVICE CARD FOR MORE INFORMATION

## Portable Graphic Recorder Field and Laboratory Use



Frequency response recorder, Model SL-4, for electrical and electrical-acoustical measurements, utilizes a patented electro-dynamic principle for the operation of the pen or stylus. Specially featured are a variable, electronically controlled writing speed and pen dampening movement.

The instrument records on a 4 in. wide chart at chart speeds of 4-1/2, 9, and 18 in. per minute selectable by manual controls. Other speeds can be furnished upon request. Various types of measurements can be recorded, since the scale function depends on the input potentiometer which can be furnished as a decibel, linear, square root or phone.

The dimensions of the SL-4 are 10-1/2 x 19 x 12 in., and the front panel is slotted for rack mounting. It can be conveniently linked with various oscillators, and analyzers. Link units are available for the most widely used beat-frequency oscillators and wave analyzers. Special link units and corresponding charts can be designed. The instrument can also be supplied with a chart take-up roll.

Sound Apparatus Co., Dept. ED, Stirling, N. J.

CIRCLE 168 ON READER-SERVICE CARD FOR MORE INFORMATION

## Torque Motor

Operated by Electronic Amplifiers



The Model 24 Torque Motor features fast response and high output force. It weighs only 11-1/2 oz and has an output conservatively rated at 8 lb of force for 3 w of input power. Designed to drive hydraulic servovalves or similar mechanisms, it may be operated by electronic, magnetic, or even transistor amplifiers.

The stroke is a full  $\pm 0.010$  in. and is proportional to input differential current. The armature is symmetrically designed so that large lateral accelerations have virtually no effect on armature position. The unit operates in the  $-65$  to  $165$  F range, but may also be ordered for operation at higher temperatures. A wide variety of coils are offered to match high and low impedance driving sources.

Raymond Atchley, Inc., Dept. ED, 2340 Sawtelle Blvd., Los Angeles 64, Calif.

CIRCLE 169 ON READER-SERVICE CARD FOR MORE INFORMATION

## ADVANCED DESIGN ... today!

### STAND-OFF and FEED-THRU INSULATORS MINIATURE and SUB-MINIATURE



Self-sealing and self-fastening Shamban Stand-Off and Feed-Thru Insulators help guided missiles reach ever higher... cut assembly costs in radar, television, and other electronic equipment. Resistant to heat, pressure altitudes, humidity, mechanical shock and vibration, they're another example of Shamban creative talents and engineering skill.



Write  
for  
Catalog

**SHAMBAN  
ENGINEERING CO.**  
11617 W. Jefferson Blvd., Culver City, Calif.

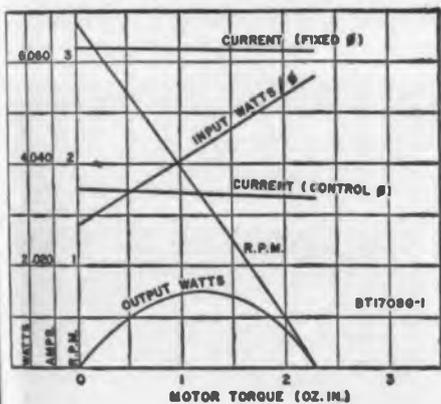
You'll find Shamban thinking in every industry.

CIRCLE 170 ON READER-SERVICE CARD

engineered for  
longer life...



If longer life is a primary requirement in your control or system application, specify the BT 1708 G-1 or any of the other servo motors made by INDUCTION MOTORS CORP. These units are built to JAN and MIL specifications, surpassing all standards for performance in extreme conditions of humidity, temperature, vibration or altitude.



#### SPECIFICATIONS • BT 1708 G-1

Two phase • Reson. Imp. 9000 ohms  
60 cycles • Two pole • 3300 free rpm  
Voltage-Reference winding: 115 volts  
Voltage-Controlled winding: 230 volts  
Weight: 1 lb.

In addition to servo motors, IMC offers a full line of AC and DC subfractional and gear motors, fans, blowers and dynamometers. Discuss your motor design and application problems with us.

**Induction Motors Corp.**

570 Main St., Westbury, L. I., N. Y.  
EDgewood 4-7070

CIRCLE 172 ON READER-SERVICE CARD

#### Missile Fire Control

Provides Automatic Programming



Built to withstand the rigid environmental requirements of jet aircraft, the custom intervalometer is a hermetically sealed control that provides automatic programming

for missile firing. Opening of rocket pods, rocket launcher extension, and other functions in complete and proper sequence of a firing mission are controlled to millisecond accuracies.

Rugged but lightweight mounting flanges are secured directly to the airframe. No special shock mounts are required to perform satisfactorily under extreme shock, temperature, and vibration conditions as outlined in MIL-E-5272, Procedure I.

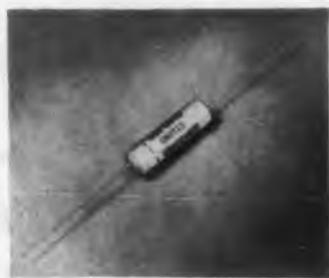
Compact size, lightweight, extreme accuracy, and standard AN connectors are the predominate features of the fire control. Incorporated in some of the other intervalometers made by the firm is the "Chronopulse" time generator, a new type of high accuracy dc time base.

Abrams Instrument Corp., Dept. ED, 606 E. Shiawassee St., Lansing 1, Mich.

CIRCLE 173 ON READER-SERVICE CARD FOR MORE INFORMATION

#### Paper Tubular Capacitor

Is Humidity Resistant



This ceramic-encased paper tubular capacitor incorporates a newly developed thermosetting plastic end seal. It will pass humidity tests at 90-95 per cent humidity over a period of 750 hr at 40 C, 500 hr at 50 C,

and 300 hr at 60 C. It will also pass a combination humidity and life test at 90-95 per cent humidity, 60 C, at rated voltage, as well as a boiling water test consisting of alternate 10 minute immersions in boiling water and water of room temperature for a total of five cycles.

Rated operating temperature range is -40 to +85 C. Available capacitance values cover the full range for tubular papers. The capacitor is impregnated with mineral oil and has high insulation resistance as well as low power factor and temperature coefficient.

United Condenser Corp., Dept. ED, 3400-06 Park Ave., New York 56, N. Y.

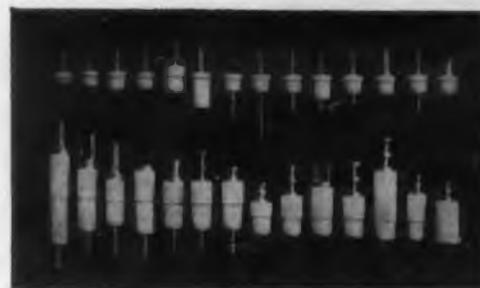
CIRCLE 174 ON READER-SERVICE CARD FOR MORE INFORMATION

Sealectro  
stocks  
hundreds  
of standard  
types

You can pick your

"PRESS-FIT"\*

TEFLON† TERMINALS



"Press-Fit" the right terminals to your particular requirements—from the outstanding selection of miniature and subminiature stand-offs and feed-thrus in various body designs, lug types, metal finishes, etc. Likewise break-away connectors, test-point jacks and contact receptacles.

Yes, hundreds of standard numbers to choose from. Carried in factory stock for quickest deliveries. Let us quote on your requirements.

#### AVAILABLE IN COLORS

And now, "Press-Fit" terminals are available in colored Teflon—white, brown, blue, red, orange, yellow, green and gray—not only for the eight RETMA color codings, but also to add a touch of extra eye appeal to any assembly.

Get your copy! This "Press-Fit" Manual, plus supplement sheets, covers the standard numbers as well as installation procedure. Be sure you have this literature in your working library. Mailed on request.

\*Trademark of the original Teflon terminal manufacturer  
†Reg. Trademark, E. I. Du Pont de Nemours & Co.



CIRCLE 175 ON READER-SERVICE CARD FOR MORE INFORMATION

True Hermetic Sealing  
assures Maximum Stability in

# AMPERITE RELAYS and REGULATORS

Simplest • Most Compact • Most Economical



STANDARD

PROBLEM? Send for  
Bulletin No. TR-81

## Thermostatic DELAY RELAYS

2 to 180 Seconds



MINIATURE

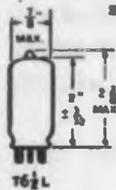
- Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.
- Hermetically sealed Not affected by altitude, moisture, or other climate changes.
- Circuits: SPST only — normally open or normally closed.

Amperite Thermostatic Delay Relays are compensated for ambient temperature changes from  $-55^{\circ}$  to  $+70^{\circ}$  C. Heaters consume approximately 2 W. and may be operated continuously. The units are most compact, rugged, explosion-proof, long-lived, and — very inexpensive!  
TYPES: Standard Radio Octal, and 9-Pin Miniature.

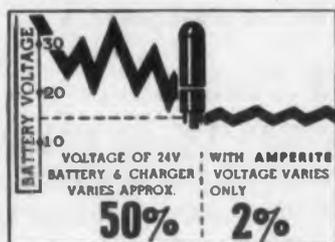
Also — Amperite Differential Relays: Used for automatic overload, under-voltage or under-current protection.

## BALLAST REGULATORS

Amperite Regulators are designed to keep the current in a circuit automatically regulated at a definite value (for example, 0.5 amp.) ... For currents of 60 ma. to 5 amps. Operate on A.C. D.C., Pulsating Current.



Hermetically sealed, they are not affected by changes in altitude, ambient temperature ( $-55^{\circ}$  to  $+90^{\circ}$  C.), or humidity. Rugged, light, compact, most inexpensive.



Write for 4-page Bulletin No. AB-51

**AMPERITE CO., Inc.**

561 Broadway, New York 12, N. Y.

Telephone: CAnal 6-1446

In Canada: Atlas Radio Corp., Ltd.

50 Wingold Ave., Toronto 10, Ont.



Individual inspection and double-checking assures top quality of Amperite products.

CIRCLE 177 ON READER-SERVICE CARD FOR MORE INFORMATION

## Pulse Power Calibrator

Offers High Accuracies



Pulse Power Calibrator PCX-1 provides a new method for measuring the power of radio frequency pulses. The equipment gives an indication, which is essentially a notch-wattmeter display, but in addition eliminates all reliance upon a pre-calibrated condition. It provides a

comparison scheme which is free of error caused by changes in voltage gain, input voltage fluctuations, parallax, or electronic instability about an operating point.

The equipment provides comparison circuits and bridge circuits which are energized rf power of the same frequency as the signal to be measured, thereby removing ambiguities produced by widely different frequencies between the calibrating device and the signal source to be measured. PCX-1 equipment provides a group of accessories required for interconnection with equipment under test, consisting of trigger cables, rf cables, cable connector adapters, and fixed attenuators. The calibrator's frequency range is 925-1225 mc. Accuracy is  $\pm 0.5$  dbm. Power input range is  $-10$  to  $+63$  dbm. Input pulse width range is 0.5 to 10  $\mu$ sec.

General Communication Co., Dept. ED, Boston 15, Mass.

CIRCLE 178 ON READER-SERVICE CARD FOR MORE INFORMATION

## Nuclear Photomultiplier

Cathode-Follower Preamp



A new preamplifier (Model N351), a simple, inexpensive, versatile cathode-follower capable of stability and linearity demanded in normal scintillation counter spectrometry, features: prewired photomultiplier (DuMont 6292) socket, low noise and low temperature coefficient resistors used throughout, triode connected 6AH6 with 80 ohm output impedance, heavy base housing to permit either vertical or horizontal operation. Power requirements: 6/3 v at 0.45 amp FIL 180 v B+ at 10 ma. (Supplied directly by the N-301 non-overload amplifier).

Hamner Electronics Co., Inc., Dept. ED, P.O. Box 531, Princeton, N.J.

CIRCLE 179 ON READER-SERVICE CARD FOR MORE INFORMATION

## Now a Frequency Meter Insensitive to Wave Form!

**VARO MODEL 6503**



Frequency range from 397-403 cps with accuracy better than 0.01%; or 370-430 cps with accuracy of 0.1%.

The VARO Model 6503 will accurately measure the repetition rate of voltage spikes, sawtooth waveforms, or badly distorted sine waves. It will also measure frequency of input signal voltage between 6 and 250 volts without need for adjustment. Write for details.

**VARO** Mfg. Co., Inc.  
2201 Walnut Street Garland, Texas

CIRCLE 180 ON READER-SERVICE CARD FOR MORE INFORMATION

## SIMPLIFIED SELECTION ... AVAILABLE FROM STOCK!

**JOHNSON  
PILOT  
LIGHTS**



For "in the field" replacement or original equipment manufacture, you'll find that it's easier and faster to specify Johnson Panel Indicators. Available in a wide variety of types, Johnson "preferred" types are stocked by parts distributors throughout the country.

Available types include: continuous indication neon types; models for high and low voltage incandescent bulbs; standard or wide angle glass and lucite jewels in clear, red, green, amber, blue or opal lenses. Specials, including those meeting military specifications are also available in production quantities, for full information write to:

Complete Catalog!  
Write today for your copy.



**E. F. Johnson Company**

3406 Second Avenue Southwest • Waseca, Minnesota

CAPACITORS • INDUCTORS • KNOBS • DIALS • SOCKETS • INSULATORS • PLUGS • JACKS • PILOT LIGHTS

CIRCLE 181 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 15, 1956

# NEW Integral Actuators on the UNIMAX sub-miniature snap-acting precision SWITCH



**Type USM** switch has four types of actuators integral with the switch body, offering these advantages:

- Factory-set switch characteristics maintained consistently, accurately.
- Faster, easier assembly with other components in your product, no exterior actuator mechanism to get in the way.
- Ganging is simpler, nothing interferes with solid stacking 4 per inch.
- Four types of actuators — pin, leaf, long-leaf, and leaf-roller.
- Electrical rating — 5 amperes 125/250 volts a-c; 2½ amperes 30 volts d-c, inductive; 4 amperes 30 volts d-c, resistive.

Write today for complete information on Unimax switches.

## UNIMAX SWITCH

Division The W. L. Maxson Corporation  
IVES ROAD, WALLINGFORD, CONNECTICUT

CIRCLE 183 ON READER-SERVICE CARD FOR MORE INFORMATION

## KNOTS WON'T SLIP

TIE EASIER AND FASTER  
WHEN YOU USE...

HEMINWAY  
& BARTLETT

NEW!

## TEFLON COATED FIBERGLASS TAPES

Newest scientific tapes... coated  
with DuPont Teflon... fireproof.  
WITHSTAND TEMPERATURES  
UP TO 600°

NEW GOVT. SPEC. Mil-T-713A now covers both our  
NYLON LACING CORDS and  
NYLON FLAT BRAIDED TAPES

TAPES are available in both Nylon and Dacron and are specially developed in wax, wax free and resin coated finishes.

FREE! Write today for free samples.

The Heminway & Bartlett Mfg. Co., ELECTRONICS DIVISION, 500 5th Ave.  
N. Y. 36 Sales Offices: Chicago, Philadelphia, Boston, Cincinnati, San  
Francisco, Los Angeles, Detroit, Charlotte, N. C., Gloversville, N. Y.,  
Wachburg, Va. Foreign Agent: Turner, Halsey Co., Inc., 40 Worth St., N. Y.

CIRCLE 184 ON READER-SERVICE CARD FOR MORE INFORMATION

## Regulated DC Source For Unattended Installations



The Model MA65A is a low voltage, high current, tubeless regulated dc source utilizing magnetic amplifier circuitry for

greater reliability. It is recommended for unattended installations because of its maintenance-free performance.

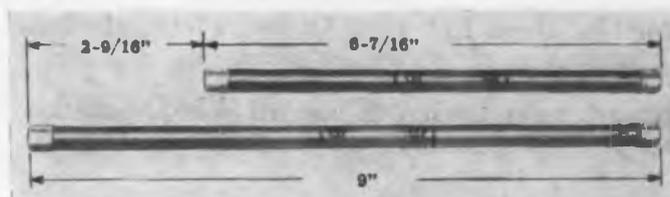
Input range is 105-125 v ac, single phase, 60 cps. Output voltage is 5.4-6.6 v dc, adjustable. Load range is 0-5 amp; ripple is 1% max. Regulation accuracy is  $\pm 0.2\%$  against line or load (1/10 to full). Recovery time is 0.15 sec. The unit is supplied for rack mounting, with a cabinet available for bench use.

Sorensen & Co., Inc., Dept. ED, Fairfield Ave., Stamford, Conn.

CIRCLE 185 ON READER-SERVICE CARD FOR MORE INFORMATION

## Tubular Rectifiers

Meet Rigid Space Requirements



Especially developed for high-voltage low current applications, these selenium tubular rectifiers are made in physical cell sizes from 1/8 to 1/2 in. diam and are rated 1-1/4, 2-1/2, 5, 10, and 20 ma dc per cell, in half-wave circuit using a condenser input filter. They are available for fuse-clip type mounting, with axial end leads or, for use under varying conditions of temperature and humidity, in hermetically sealed glass tubes.

The new cells have a reverse voltage rating of 33 v rms and are approximately 20% thinner than previous units. This higher rating and reduced thickness per cell offers a compact, efficient rectifying unit and permits rigid space and performance requirements to be met.

A new 33 v selenium power rectifier cell is also available. Cells range in physical size from 1 x 1 in. to 5 x 6 in. and are designed for stud, bolt, or bracket mounting. They feature "solid stack" assembly and are rated from 0.180 to 10.0 amp per cell on a single phase full-wave bridge basis in accordance with the latest NEMA approved specifications.

Union Switch & Signal, Division of Westinghouse Air Brake Co., Dept. ED, Pittsburgh 18, Pa.

CIRCLE 186 ON READER-SERVICE CARD FOR MORE INFORMATION

## Now available in 3 stock sizes



## OHMITE® AXIAL-LEAD VITREOUS-ENAMELED RESISTORS

If you want a compact, wire-wound resistor for your tough jobs, specify Ohmite axial-lead resistors. These power-type units are designed to stand up under high temperatures. All parts—core, resistance wire, vitreous-enamel coating, and terminal bands—are "thermally balanced" to expand and contract as a unit. Terminals remain firmly anchored, cracking is eliminated, and moisture cannot enter the resistor.

Write for Bulletin No. 147-B

OHMITE MFG. CO.  
3643 Howard St., Skokie, Ill.  
(Suburb of Chicago)

Be Right with

## OHMITE®

RHEOSTATS • RESISTORS • RELAYS  
TAP SWITCHES • TANTALUM CAPACITORS

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# KOILED KORDS\*

THAT EXTEND AND RETRACT

*Solve*  
**MANY DESIGN PROBLEMS...**

KOILED KORDS retractile cords extend to approximately six times their retracted length. They are neat and orderly and never sag, droop, drag or tangle in moving mechanisms. Write for Bulletin KK-52 showing many uses.



**ON  
MACHINES  
THAT MOVE**

If the machine and power cord move, KOILED KORDS are the most effective and safest power cords to use.



**ON  
COMMUNICATIONS  
DEVICES**

KOILED KORDS are most convenient and can be quickly and neatly "stowed" either inside or outside instrument housings.



**ON  
"IN-A-DRAWER"  
EQUIPMENT**

KOILED KORDS make it easy to service units that are concealed and they avoid possibility of ungainly straight cords causing mechanical failures.

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## Koiled Kords

INCORPORATED

Box K, New Haven 14, Connecticut

\*KOILED KORDS is a trade mark of KOILED KORDS, INC.  
Manufactured by Whitney Blake Company.

CIRCLE 189 ON READER-SERVICE CARD FOR MORE INFORMATION

## DC Amplifier

For Airborne Instrumentation



The Model 2HMA-2 is a dc amplifier with an isolated input circuit. It is particularly suited for airborne thermocouple or strain gage bridge measurements. Flight test applications where switches scan as many as 150 points/sec are easily handled by the amplifier's less than 5 ms

rise time and flat response from dc to 400 cps. Amplifier output is 0-5 v dc for the input to an RDB telemetering system or magnetic tape recorder.

A "Second Harmonic Converter" is used as the input modulator in place of a mechanical chopper. The converter permits complete isolation of the input from the amplifier chassis and circuit ground, resulting in rejection of electrical noise and pickup from circulating ground loop currents. For temperature measurements, an automatic cold junction compensator can be provided for the particular type of thermocouple to be used.

Doelcam, Div. of Minneapolis-Honeywell Regulator Co., Dept. ED, 1400 Soldiers Field Rd., Boston 35, Mass.

CIRCLE 190 ON READER-SERVICE CARD FOR MORE INFORMATION

## Control System

For Carrier Measurements



The Type 67 Universal Control System is a complete, miniaturized carrier measurement system available in various models to operate all types of transducers, including variable permeance, variable reluctance, variable dif-

ferential transformers, strain gages, potentiometers, and variable capacitance transducers. The unit measures by panel indicator or external recorder.

Components of the Type 67 are a regulated power supply, stabilized oscillator, adjustable ac bridge circuit, highly stable carrier amplifier, linear demodulator, and a panel read-out system, with indicator and 1000 division read-out dial. Single, two, and three channel models are available.

Crescent Engineering and Research Co., Dept. ED, 11632 McBean St., El Monte, Calif.

CIRCLE 191 ON READER-SERVICE CARD FOR MORE INFORMATION

## CORNING GLASS MIDGET TRIMMERS ...ROTARY AND DIRECT TRAVERSE TYPES



available through

**ERIE**  
*distributors*

The Corning Glass Midget Rotary Trimmer Capacitor offers outstanding performance coupled with economy and is made with a variety of mounting types and terminals.

The Corning Glass Midget Direct Traverse Type Trimmer Capacitor possesses extreme ruggedness combined with thermal stability and a smooth tuning characteristic. Used extensively in Military Field Communications and similar equipments, wherever extreme operating conditions are encountered.

Write to us for the Distributor's name in your locality.

**ERIE**  
*electronics*

ERIE ELECTRONICS DISTRIBUTOR DIVISION  
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CIRCLE 192 ON READER-SERVICE CARD FOR MORE INFORMATION



## Versatile 'DIAMOND H' Relays

### Handle Many Different Jobs

"Diamond H" Series R hermetically sealed aircraft type relays perform outstandingly over such a broad area that they are frequently used to do many different types of jobs in a given application. For example, they give excellent reliability in dry circuits yet will carry up to 10 amperes in power circuits... or even 20 amperes for reduced life requirements.

Savings inherent in uniform size and mounting arrangements for one relay family can be multiplied by the lower inventory of spare parts needed when a single model is used for two or more functions. Matching or surpassing requirements of USAF Spec. MIL-R-5757B as well as important provisions of MIL-R-25018, tens of thousands of Series R 4 PDT and DPDT relays are in use, engineered for:

Various brackets of vibration resistance from 10 to 2,000 cps, temperature ranges from -65° to +200° C, coil resistances from 1 to 50,000 ohms, operational shock resistance of 30, 40 or over 50 "G" and mechanical shock resistance to 1,000 "G", contact capacities from 350 V., D. C., 400 MA, to 10 A., at 30 V., D. C., as well as signal circuits.

For complete information, send for a copy of Bulletin R-250.

**THE HART MANUFACTURING COMPANY**  
210 Bartholomew Avenue, Hartford, Conn.

CIRCLE 193 ON READER-SERVICE CARD FOR MORE INFORMATION

**marion**  
advancement  
in instrument  
design

new  
**MEDALIST**  
meters



Greater readability and modern styling in minimum space. Interchangeable with ASA/JAN 2½ and 3½ inch sizes. Up to 50% longer scale in same space as ordinary type. Available in various colors. Complete data on request.

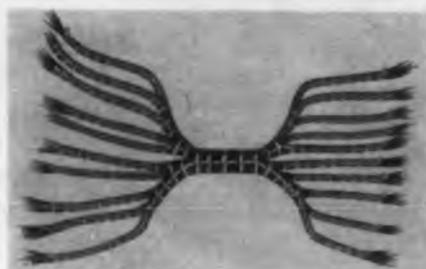
\*Trade Mark  
Patents Pending



**marion**  
meters  
marion electrical  
instrument company  
GRENIER FIELD—Manchester, N. H., U.S.A.  
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CIRCLE 195 ON READER-SERVICE CARD

### Lacing and Winding Tape Of Glass and Teflon



"Ben Har Braided Tapes," a line of lacing tapes for wire harnessings and windings, use duPont Teflon coated directly

on glass fibers before braiding. A rough texture is achieved which improves the tying ability of the tape while eliminating the abrasive action of the glass.

The tape is applicable to a temperature range of -100 to +500 F, and remains pliable throughout the entire range. It does not shrink and cut through wire insulation. It is wax-free and will not support fungus growth; yet, because of the underlying glass braid, knots stay tight permanently. It is completely inert to most known chemicals and oils, is non-absorbent, and is practically ageless.

The new tape can be used in all wire harnessing where heat might be a deciding factor against conventional lacings. It is available in natural color (off-white) in 0.048, 0.062, 0.090, and 0.22 in. widths; in 250 and 500 yard spools, and a Universal 1/4 lb tube. Nine additional colors may be had on special order.

Bently Harris Manufacturing Co., Dept. ED, Conshohocken, Pa.

CIRCLE 197 ON READER-SERVICE CARD FOR MORE INFORMATION

### Traveling Wave Tube For the S-Band Region



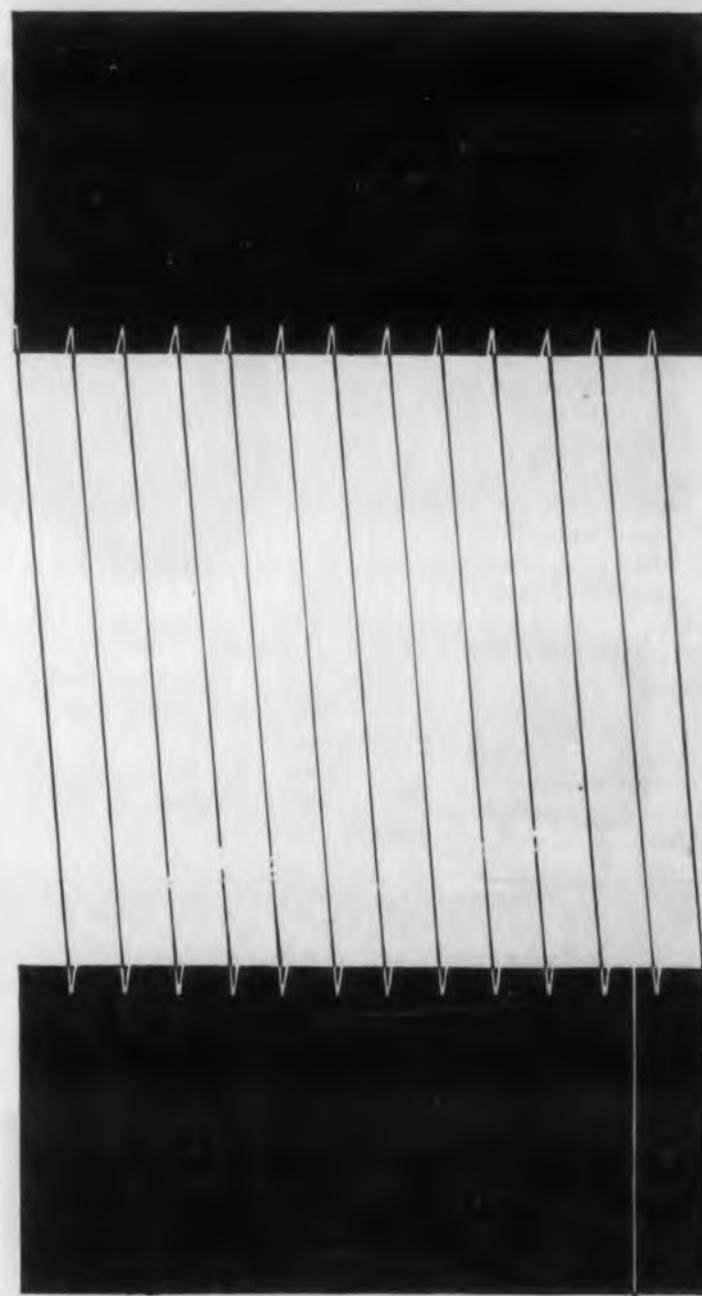
Amplification over a wide range of frequencies in the S-band region can be obtained by the use of the 1161/BL850 Traveling Wave

Tube. Peak power output of 1 kw can be obtained with an accelerating voltage of 5800 v. A magnetic field of 1000 gauss is required to focus the electron beam. Driving power needed is approximately 1 w. Average power output without forced air cooling is 1 w.

The tube is mounted in a metal capsule which supports it in the focusing solenoid and also houses the input and output matching cavities. Weight of the tube and capsule is 5 lb, and the tube is 17 in. long by 1-7/8 in. diam.

Bomac Laboratories, Inc., Dept. ED, Salem Rd., Beverly, Mass.

CIRCLE 198 ON READER-SERVICE CARD FOR MORE INFORMATION



### UNIFORMITY

UNIFORMITY of Essex Extra-Test Magnet Wire assures maximum turns in available space — freedom from broken wires, crossed turns, pile-ups, runbacks, spaced turns, and frequent tension adjustments. For superior performance in the most exacting appliances... specify Essex. Extra-Test means EXTRA VALUE!



**ESSEX** <sup>EXTRA TEST</sup> **MAGNET WIRE**

DIVISION ESSEX WIRE CORPORATION  
Fort Wayne 6, Indiana

MANUFACTURING PLANTS — Birmingham, Alabama; Anaheim, California; Fort Wayne, Indiana; Detroit, Michigan.

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CIRCLE 199 ON READER-SERVICE CARD FOR MORE INFORMATION

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FASTENINGS**

**RIGHT-OFF-THE-SHELF**  
for immediate delivery

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- Bolts & Cap Screws
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- Machine Screws
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- Pipe Fittings
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- Stud Bolts

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Telephone: Little Falls 4-2300  
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1956 ELECTRONIC DESIGN • September 15, 1956

for printed circuits  
**PHILCO** uses  
**INSUROK®** laminate



Philco engineers use Richardson Copper-Clad INSUROK T-725 laminate for printed TV and radio circuits.

In the manufacture of printed circuit materials, the most important single consideration is the laminate. Richardson Copper-Clad

INSUROK T-725 is a laminate of outstanding excellence... its electrical qualities remain remarkably stable under repeated temperature and humidity cycling.

For further information, write, or phone... Chicago number, MAAnsfield 6-8900.



*The* **RICHARDSON COMPANY**  
LAMINATED AND MOLDED PLASTICS

Dept. 11, 2682 Lake St., Melrose Park, Ill.

CIRCLE 201 ON READER-SERVICE CARD FOR MORE INFORMATION

**SANGAMO "GY" FLATPAK**



Small Size  
High Efficiency  
Fast Starting  
High Power  
Output

compact, efficient, dynamotor

The FLATPAK is a rugged, precision engineered dynamotor that is designed for mobile radio and general commercial use. It is of laminated field design, and its compact size makes it ideal for applications where space is a problem. Available in ratings through 110 watts continuous duty and 300 watts intermittent duty. Output to 650 volts.

Bulletin 1530 gives full information on these and other Sangamo Dynamotors. Mail the coupon for your copy.

SG56-6

**SANGAMO Generators, Inc.**

Dept. D, Springfield, Ill.

Please send me Dynamotor Bulletin 1530.

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DYNAMOTORS  
•  
ROTARY CONVERTERS  
•  
MOTOR GENERATORS  
•  
GAS ENGINE GENERATORS  
•  
SPECIAL DC MOTORS

CIRCLE 202 ON READER-SERVICE CARD FOR MORE INFORMATION

**Synchronous Timing Motor**

Develops High Torque



A new synchronous timing motor designated Series A2334 develops high torque while retaining the many advantages of hysteresis type motors. The motor is designed for high volume applications in the appliance, vending, animated display and industrial fields.

Torque rating is 10 oz in at 1 rpm. Speeds of 1, 2, 4, 6, 8, and 10 rpm are available in right and left hand rotation. A heavy duty gear train permits transmitting continuously full output of the motor. Compactly constructed, the motor is only 1-13/32 from front to back.

Haydon Mfg. Co., Inc., Dept. ED, 245 E. Elm St., Torrington, Conn.

CIRCLE 203 ON READER-SERVICE CARD FOR MORE INFORMATION

**Chassis Kit**

Aids Experimental Work



The "Experimenter's Chassis" kit provides quick set-up of electronic circuitry with simple hand tools. Although intended mainly for mock-ups, it is also suitable for more

permanent use and may be mounted on racks or in cabinets with added adapter plates. The construction is highly flexible, and parts can be readily cut to make sizes other than those supplied.

The main wiring deck, consisting of a sheet of phenolic board having a uniform hole pattern, is mounted on aluminum channels. Decks are 4-3/4 x 8-1/2 in. or 4-3/4 x 17 in. and are packed with a variety of accessories.

An outstanding feature is the "Push-In Terminal," which is a formed strip brass terminal having a partially tubular end that fits snugly into the holes of the board. The upper portion of the terminal has a narrow tapered slot with serrated edges. When a wire of any size between 0.030 and 0.045 in. is inserted, the fingers grip the wire firmly enough, so that for temporary testing the connections need not be soldered.

Vector Electronics Co., Dept. ED, 3352 San Fernando Rd., Los Angeles 65, Calif.

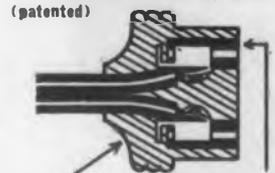
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*At last!*

- Positive Moisture Seal
- Perfect Strain Relief
- Arc-over Prevention
- Corona Suppression

IN SIMPLE, RUGGED CONNECTORS USING

**ALDEN "IMI"**  
(integral molded insulation)  
**TECHNIQUE**  
(patented)



Contacts and lead assembly molded as integral insert.

Proper retention force of resilient punch press contacts maintained by insulation relieving feature.



NOW — for the first time — you can have sealed connectors without tedious preparation, intricate assembly, or lengthy curing time.

INSTEAD — Alden "IMI"

using the patented techniques shown above make it possible to mold the insulation directly around the contacts and leads in one compact, lightweight assembly.

This advanced technique has now made possible a whole new series of reliable connectors and unit cable assemblies. Write today for the new Alden "IMI" Connector Guide.

**ALDEN PRODUCTS COMPANY**

9139 N. MAIN ST., BROCKTON, MASS.

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**NOW!**  
over 15 million  
**Microdot coax combinations**

Microdot cuts design time by multiplying possibilities... with the world's smallest, lightest microminiature coax connectors and cables available at 50, 70 or 93 ohms to meet your rigorous environmental requirements. Write today for applications data

**MICRODOT**  
data  
example  
**70 OHM**

**CABLES**

Z<sub>0</sub>  
70 ohms  
C  
21 mmf/ft  
Δ (400 mc)  
.17 db/ft  
V  
70% (Teflon)  
T  
up to 400° F

**CONNECTORS**

"S"  
Screw Series  
"QC"  
Quick Connect  
"P"  
Pressurized

**Available:**

Plugs, Jacks, Receptacles, BNC Adapters, Feed-throughs and special designs.



1/3 BNC diameter  
1/10 BNC weight!



**MICRODOT**  
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50 PASADENA • CALIF.

CIRCLE 206 ON READER-SERVICE CARD FOR MORE INFORMATION

## Portable MB Meter MEASURES VIBRATION



This improved Model M6 vibration meter teams up with an MB Vibration Pickup to give you the facts on vibration. It measures voltage generated by pickup... directly in terms of amplitude, velocity or acceleration of the vibratory motions.

Four pickups can be connected to this meter... a push-button selector switch enables you to read any one at a time. Built-in 30, 70, and 110 cps high-pass filters are standard.

The meter is portable, compact, ruggedized and operates on standard AC. Write for more data.

**MB manufacturing company**  
A DIVISION OF TEXTRON AMERICAN, INC.  
1061 State Street, New Haven 11, Conn.

CIRCLE 208 ON READER-SERVICE CARD FOR MORE INFORMATION

## specify standard

### FLEXLOC SELF-LOCKING NUTS

#### Regular and Thin Types



Regular FLEXLOCS are one-piece, all-metal, standard height nuts that lock securely, even under extreme vibration. Thin nuts have the same one-piece, all-metal construction and the same positive locking principle, but these nuts are approximately 30% thinner. Your FLEXLOC industrial distributor stocks both types: regular FLEXLOCS in sizes from #0 to 2"; thin FLEXLOCS in sizes from #6 to 1 1/2". Ask him for catalog information and samples. Or write STANDARD PRESSED STEEL Co., Jenkintown 12, Pa.

STANDARD PRESSED STEEL CO.

**SPS**

JENKINTOWN PENNSYLVANIA

FLEXLOC LOCKNUT DIVISION

CIRCLE 209 ON READER-SERVICE CARD FOR MORE INFORMATION

## Oscillator Covers Acoustic Range



The A.F. Oscillator 816 gives an output from 30 cps to 30 kc in three ranges. It is intended for adjustment of af amplifiers in PA work and af stages in radio.

The output level is adjustable from 10  $\mu$ v to 10 v by an accurate attenuator system. An automatic regulation circuit keeps the output level constant with changes in frequencies.

Output impedance is not more than 5 k. Distortion is 3 per cent for 30-50 cps and 2 per cent above 50 cps. Supply is 110-220 v, 50/60 cps. Size is 10-1/8 x 7-5/8 x 7-1/2 in. and weight is 12 lb 2 oz.

Compagnie Generale De Metrologie, Dept. ED, P. O. B. 30, Annecy, France.

CIRCLE 210 ON READER-SERVICE CARD FOR MORE INFORMATION

## Recording Heads

### For Computer and Electronic Uses



A line of multiple channel magnetic recording and playback heads is offered for a wide variety of uses, such as computer input-output equipment, memory drums, disks, and

telemetering recording. The audio field is also covered, with heads for 1/4 in. tape, and 16 mm and 35 mm film. Illustrated are typical units: a binaural head for 1/4 in. tape, a 4-channel Cinemascope motion picture head, a 7-channel head for 5/8 in. tape, and a 14-channel, interlace head for 1 in. tape.

The construction of these heads assures complete and simple interchangeability. The elimination of any potting compound at the head surface prevents oxide buildup, and the use of a laminated core consisting of strips of a special alloy 0.0002 in. thick results in high efficiency and the ability to withstand wide temperature variations, vibration, and shock.

All heads are subject to a wide variety of modifications to suit the individual needs of the customer, such as low and high impedance, and bit density capacity for digital use.

J. B. Rea Co., Dept. ED, 1723 Cloverfield Blvd., Santa Monica, Calif.

CIRCLE 211 ON READER-SERVICE CARD FOR MORE INFORMATION



## Effective new shielded room requires no maintenance

Filtron, Inc.—electronic components manufacturer—selected Armorply panels for a shielded room that's easy to assemble, move, or alter in shape with ordinary labor. Special compression joints end need for soldering in this room, erected by Shielding, Inc. And Armorply requires no maintenance; gives effective shielding and a neat appearance for decades. (Armorply available with copper, lead, aluminum or other metal faces.) For full information and a free Armorply sample, write:

### Weldwood® Armorply®

UNITED STATES PLYWOOD CORPORATION  
Dept. ED9-15-56, 55 West 44th St., New York 36, N. Y.

CIRCLE 212 ON READER-SERVICE CARD FOR MORE INFORMATION

## New booklet\* describes latest uses for Straits Tin in major industries



New booklet contains up-to-the-minute information about one of our most useful metals—Straits Tin from Malaya. Explains how tin's properties help each major industry, gives specific examples of new applications solving manufacturing problems. Sixteen pages, fully illustrated, factual and concise.

Send for your  
free copy now

\*Prepared especially for busy executives, materials selectors, design and production engineers. Your copy awaits your request.

The Malayan Tin Bureau  
Dept. 12J, 1028 Connecticut Avenue  
Washington 6, D.C.

Please send me a free copy of the new booklet,  
"STRAITS TIN FROM MALAYA, Its New Importance  
to American Industry."

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Company \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

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sure . . . if the odds  
are in YOUR favor . . .

**DECISION/INC**—nationwide specialists in recruitment of engineering personnel—have an active and enviable record in developing job opportunities for men who want bigger salaries and a chance for greater personal achievement.

**DECISION/INC** is retained by more top-ranking firms throughout the nation than any other organization to find the right man for each job. This confidential service costs you nothing.

It takes **TIME—MONEY—EFFORT** to improve your job situation. If you are an engineer or scientist, particularly in the **ELECTRONIC—AERO-NAUTICAL** or **GUIDED-MISSILE** field, **DECISION/INC** will do this quickly, effectively at no cost to you.

**HOW?** Our placement specialist develops a plan "tailor-made" for you—which includes a resume of your experience . . . and then a review by selected companies leading to confidential interviews at your convenience and our client's expense.

**NOW** is the time for **DECISION!**

All you do now is . . . send us your name, home address, job interest or title. We take it from there.

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President—  
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Publishers of the authoritative Engineers' Job Directory

**CIRCLE 215 ON READER-SERVICE CARD FOR MORE INFORMATION**



### New miniature disc cathodes . . . ... REDUCE HEAT, WEIGHT AND SIZE IN PORTABLE TV SETS

They save up to 50% of required heater power, in contrast with most disc cathodes—hence less heat inside the cabinet. 25% smaller size makes possible a shorter picture tube with a narrower neck . . . a smaller deflection yoke . . . and smaller overall cabinet size. If you are designing picture tubes for portable TV, and if you plan to use either 450 or 300 ma. heaters, get complete information on these new Superior ED-1-7 miniature disc cathodes. Write Superior Tube Company, 2050 Germantown Ave., Norristown, Pa.

## Superior Tube

The big name in small tubing  
**NORRISTOWN, PA.**

Johnson & Hoffman Mfg. Corp., Mineola, N.Y.—an affiliated company making precision metal stampings and deep-drawn parts such as those used in the electron guns that go with this new cathode.

**CIRCLE 216 ON READER-SERVICE CARD FOR MORE INFORMATION**

## Counter Timer

Makes Many Measurements



The Model 226A Universal Counter Timer is a multi-purpose portable instrument designed for precise measure-

ments of frequency, frequency ratio, period (1/frequency), and time interval. Pressure, velocity, acceleration, displacement, flow, rps, rpm, etc., may be measured with suitable transducers. It may also be used as a secondary frequency standard.

Features include: simplified color coded controls and direct read-out in kc, mc, sec, or ms, with automatic decimal point indication; provision for oscilloscope marker signals for trigger level adjustment of start and stop points for time interval measurement of complex waveforms; and three independent continuously adjustable trigger level controls permitting full rated sensitivity at any voltage between  $\pm 300$  v. Small increments of voltage which are ordinarily masked by attenuators are easily selected, even though high voltage bias levels, voltage steps, square waves, etc., are present.

Computer-Measurements Corp., Dept. ED, 5528 Vineland Ave., North Hollywood, Calif.

**CIRCLE 217 ON READER-SERVICE CARD FOR MORE INFORMATION**

## Tachometer Has Pancake Design



The Model 5 "Wac-Tac" provides a closely-coupled speed indicator to be used on integral horsepower motors and automatic machinery. Its extremely thin "pancake" design provides a

minimum of protrusion beyond the machine to which it is attached. It also provides a sturdy mounting means.

The unit delivers an ac voltage whose frequency and magnitude are linear with speed, making the design particularly useful for controls sensitive to either frequency or voltage. The generator sinusoidal voltage may be as high as 25 v per 100 rpm, and the frequency is 30 cps per 100 rpm. No sliprings, brushes, or contacts are employed.

The model 5 is available for mounting within the frame of the motor or machine, or for external attachment. Other types and sizes are available.

Wac Engineering Co., Dept. ED, Dayton 2, Ohio.

**CIRCLE 218 ON READER-SERVICE CARD FOR MORE INFORMATION**

## NEW TUBING CATALOG

...Covers  
small seamless  
tubing and small tubular components



Our new catalog is just off press, and a copy is yours for the asking. Contains up-to-the-minute data on Uniform's complete line of fine seamless tubing in aluminum alloys, copper alloys, nickel alloys, stainless and low carbon steel . . . OD's from .625 to .005 in.

Also covered in detail are such special products as pointer tubing, coil forms, and metal-shielded wire, as well as Uniform's complete forming and machining service. Write for your free copy today.

A complete small tubing service  
Straight • Formed • Machined



## UNIFORM TUBES, INC.

1200 Level Road, Collegeville 2, Pennsylvania

Chicago, Ill., SHeldrake 3-9033  
St. Paul, Minn., Midway 6-7963  
Pasadena, Cal., RYan 1-9534

**CIRCLE 219 ON READER-SERVICE CARD FOR MORE INFORMATION**

## General-purpose, Compact, Inexpensive Laboratory-type Unit Amplifier



Type 1206-B Unit Amplifier: \$85.00

3 Watts Output at Audio and Ultrasonic Frequencies

Frequency Response down less than 3 db at 2 cycles and 500 kc at 10 volts output

Power Output is 3 watts from 10 c to 50 kc; 1.5 watts 5 c to 100 kc and 0.5 watt at 250 kc, with 300 volt plate supply, 600-ohm load

Harmonic Distortion less than 1% with 2 watts into 600 ohms from 20 c to 40 kc

Voltage Gain 50 to 1 (34 db) with no load

This amplifier plugs directly into one of several G-R Unit Power Supplies.

## GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts, U. S. A.  
90 West Street NEW YORK • 8055 13th St., Silver Spring, Md. WASHINGTON, D. C.  
1150 York Road, Abington, Pa. PHILADELPHIA  
920 S. Michigan Ave. CHICAGO 5 • 1000 N. Seward St. LOS ANGELES 38

**CIRCLE 220 ON READER-SERVICE CARD FOR MORE INFORMATION**



## SLIP RINGS

COMPLETE SLIP RING ASSEMBLY

This special division of D. E. Makepeace is completely staffed with engineering specialists to design and manufacture all types of slip rings and rotating electro-mechanical equipment, for your particular requirements.

# Makepeace

ENCELHARD INDUSTRIES



ADVANCED STAMPED SLIP RING DESIGN

We will design or manufacture to your requirements.

D. E. MAKEPEACE COMPANY  
Division of Union Plate and Wire Co.  
Attleboro, Mass.

Prime source for Slip Ring Assemblies, Brush Block Assemblies, Specialized Wave Guide and Tubing, Collector Rings and Brushes.

CIRCLE 222 ON READER-SERVICE CARD FOR MORE INFORMATION

## Brew Delay Lines

Distributed Constant  
Lumped Constant  
Ultrasonic



Here are some reasons why you can be sure your requirements will be fully satisfied when you come to Brew for delay lines:

- custom built to your specifications
- wide experience in all type lines
- advanced packaging techniques
- special manufacturing and testing procedures
- modern facilities and skilled personnel
- exacting quality control
- continuous research and development program

Send us your specifications or send for Catalog 54 giving the complete Brew story.

BREW

Richard D. Brew and Company, Inc.  
Concord, New Hampshire  
design development manufacture

CIRCLE 223 ON READER-SERVICE CARD FOR MORE INFORMATION

## Digital Voltmeter

Has 0.1 mv Sensitivity



This four-digit, ac-dc digital voltmeter automatically measures ac voltage with 0.1 mv sensitivity.

Reading time averages 2 sec on ac, and 1 sec on dc. Readings are made automatically

and presented on 1 in. high numerals.

Range of the instrument is 0.001 to 999.0 v dc and 0.0001 to 999.9 v ac. Range switching is manual on ac but automatic on dc. The ac accuracy is 0.1% of full scale; dc accuracy is  $\pm 1$  digit. Frequency response is 30-10,000 cps at 10 megohms, 20 mmfd. The response curve is flat over the full range. Stability is 0.01% from 40 to 120 F, with automatic dc calibration. Ac calibration, set at the factory, can be adjusted to correct for long-term drifts.

The instrument is designed for mounting in a standard 19 in. rack. Panel height is 14 in. Where space is limited, the read-outs and controls may be miniaturized to 1-3/4 in. panel for rack mounting with 1/2 in. high numeral display. The instrument may also be modified to operate all types of printers.

Electro Instruments, Inc., Dept. ED, 3794 Rosecrans St., San Diego, Calif.

CIRCLE 224 ON READER-SERVICE CARD FOR MORE INFORMATION

## Miniature Connectors

Withstand High Heat, Altitude



These miniature, high altitude, high temperature connectors are capable of operation at any altitude and temperature up

to 400 F (continuous operation). Higher temperatures may be applied for short-lived systems. This line of connectors is rated at 250 v ac and 500 v dc. Tests have shown voltages of 3500 v ac are required to cause voltage breakdown at 125,000 ft.

Standard connectors are available in 1, 3, and 7-contact configuration. A 7-contact connector is in a housing of 7/16 in. dia. The connectors are designed to meet MIL-C-5015B.

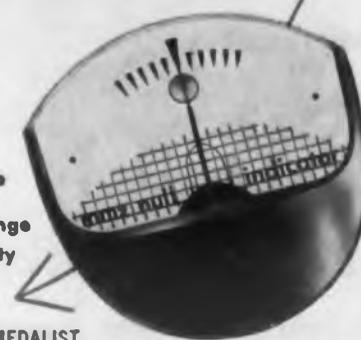
Typical connector weight is 0.04 lb. Materials are beryllium copper, aluminum, and teflon. There are no resonances through 2000 cps.

R. A. Castell & Co., Dept. ED, 740 Salem St., Glendale 3, Calif.

CIRCLE 225 ON READER-SERVICE CARD FOR MORE INFORMATION

marion  
advancement  
in instrument  
design

new  
**MEDALIST\***  
null  
indicator



readable

wide range  
sensitivity

Modern MEDALIST design provides for greater readability and modern styling in minimum space. Unique core and magnet structure provides expanded sensitivity at null point and sharp attenuation of sensitivity as pointer departs from null point. Interchangeable with ASA/JAN 2 1/2" sizes. Standard and special colors. Engineering data on request.

\*T.M. Reg. U.S. Pat. Off.  
U.S. & Foreign Patents

marion



me ters

marion electrical  
instrument company

GRENIER FIELD—Manchester, N. H., U.S.A.

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CIRCLE 226 ON READER-SERVICE CARD FOR MORE INFORMATION

# Wilmad

ELECTRONIC  
ENGINEERS!

FOR ECONOMY AND EFFICIENCY  
DESIGN WITH  
PRECISION GLASSWARE!

To keep costs down and yet get the maximum efficiency in electronic parts and sub-assemblies, more design engineers are turning to glassware.

The reason is simple: the amazing tolerance limits, the low cost, and the unbelievable accuracy and uniformity of Wilmad precision glassware have made many metals, plastics and ceramics far too expensive.

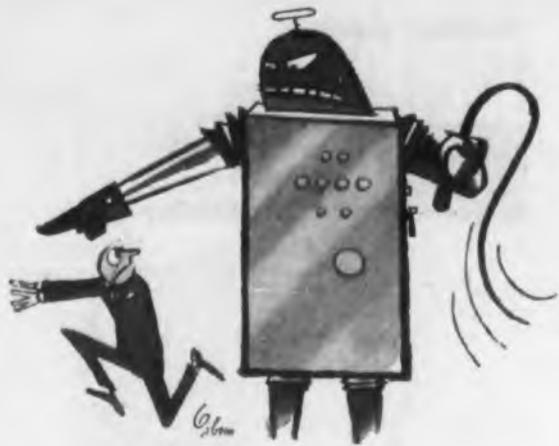
If you design electric or electronic devices of any kind such as wave guide tubes, UHF tuners and cavities, voltage regulators, capacitors, dashpots, etc., investigate the economy and efficiency of precision glassware. Our engineers welcome the opportunity of discussing any of your design problems with you. Send for our new bulletin today.

# Wilmad

GLASS COMPANY, INC.

LANDISVILLE, N. J.

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## Ruled by a Robot?

Dominated by a mechanical monster? Comes the revolution!

Just write today and learn how 500 types and sizes of



are helping to revolutionize the size of robots, machines and precision instruments, making them smaller, lighter, smoother (and kinder!)

**\* MINIATURE PRECISION BEARINGS, INC.**  
7 Precision Park, Keene, N. H.

CIRCLE 229 ON READER-SERVICE CARD FOR MORE INFORMATION

## Servo Engineers

just what you need!

- Zero Backlash
- Low Inertia
- High Flexibility
- Versatility
- Long Life
- Moderate Cost



Renbrandt Flexible Couplings are made in a wide variety of sizes for 1/16" through 1/2" shafts in all combinations and have wide application for servo mechanisms, computers, and wherever else precision performance is required. Materials and finishes meet JAN specifications.

Specify Renbrandt Flexible Couplings and be sure of positive performance. Fast delivery on prototype or production quantities. Send for complete catalog.

**Tinymite Flexible Coupling**  
Low cost. Thousands of uses for manual controls, tuners, plug-in units, sub-miniaturization, etc. 1/2" dia. x 11/16" long. For 1/4" and/or 3/16" shafts. No backlash. Insulated.

**Renbrandt, Inc.**  
Dept. ED, 98 Kirkland St.  
Cambridge 38, Mass.  
Telephone: TRowbridge 6-6560

CIRCLE 230 ON READER-SERVICE CARD FOR MORE INFORMATION

## Coaxial Constant Mismatch

DC to 4500 mc



Model RDL-2 Coaxial Constant Mismatch is featured in a new line of coaxial precision terminations and attenuators, operating from dc to 4500 mc.

The Mismatch is produced in VSWR's of 1.25, 1.5, 2.0 and 2.5.

The use of evaporated metal resistors throughout and of sealed construction make the units suitable for field, as well as laboratory use.

Radar Design Corp., Dept. ED, 210 Fifth Ave., New York 16, N. Y.

CIRCLE 231 ON READER-SERVICE CARD FOR MORE INFORMATION

## Six-Decade, Event Timer

JAN Approved Components



Model 2100, a 6-decade, digital timer is a compact and accurate instrument having a resolution of 1 ms and

a maximum indication of 999.999 sec. The timing frequency is directly obtained from a 1000 cps tuning-fork oscillator whose accuracy is 0.001 per cent from 0 to 75 C. Specifications: start and stop trigger input: 10 to 100 v common or separate; power: 117 ±12 v, 60 cps, 25 w; size: 19 x 3-1/2, 7 in. deep; weight: 16 lbs.

Hupp Instrumentation, Dept. ED, 2119 Sepulveda Blvd., Los Angeles, Calif.

CIRCLE 232 ON READER-SERVICE CARD FOR MORE INFORMATION

## Squeeze Gun

Provides Fine Graphite Spray



This container and gun sprays graphite with a squeeze of the fingers. It is small enough to hold in the hand and sprays dry lubricant at its target while held in any position.

Enough graphite is contained in the unit to permit several thousand "shots" of lubrication to parts and pieces needing lubrication. A rubber "squeeze-type" bulb is attached to the container to provide a fine graphite spray that is easily directed to the target without squirting or clogging. The gun is offered at very low cost.

Servwell Products Co., Dept. ED, Cleveland 3, Ohio.

CIRCLE 233 ON READER-SERVICE CARD FOR MORE INFORMATION

## Berkeley

NEWS NOTES



## NEW IN-LINE, IN-PLANE READOUT

- One-plane presentation; easily read from any angle
- Reduces fatigue, reading error
- Speeds data observation
- High reliability, low maintenance

### BRIEF SPECIFICATIONS:

No. digits: 4, 5 or 6  
Digit size: 3/4" to 1 1/4"  
Operating speed: To 15 readouts per second  
Input: Binary voltages from counting instruments  
Overall dim.: 5 1/2" H x 20 3/4" W x 17" D; 35 lbs.  
Price: \$610.00 (4 digit) to \$775.00 (6 digit) (f.o.b. factory)

Write today for complete data; please address Dept. D9.

**Berkeley**

division

105

BECKMAN INSTRUMENTS INC.

2200 Wright Avenue • Richmond 3, Calif.

CIRCLE 234 ON READER-SERVICE CARD FOR MORE INFORMATION

Standardized Electronic Hardware

IMMEDIATE DELIVERIES



World's Largest Stock

Get your line into production without delay with immediate deliveries from the world's largest stock of silver plated terminal lugs. Over 21 million pieces! Prompt service also on standard and special terminal boards and etched circuits, including "Wrap-Around," "Plated-Thru" and "Flush" circuits. Write for latest catalog covering our complete line of electronic hardware. Please address Dept. 7.

**U. S. ENGINEERING CO., INC.**

A Division of Litton Industries, Inc.  
521 COMMERCIAL STREET • GLENDALE 3, CALIFORNIA

CIRCLE 235 ON READER-SERVICE CARD FOR MORE INFORMATION

# WECKESSER



*molded*  
**BLACK NYLON  
SCREWS  
and  
NUTS**

Acid resistant . . .  
Need no insulation . . .  
Can't rust . . .  
Can't corrode . . .

● **CUT ASSEMBLY TIME**

6-32, 8-32 and 10-32 in stock. Actual production samples will give you the whole story. Write on your letterhead.

**WECKESSER COMPANY**

5703-05 Northwest Hwy. • Chicago 30, Ill.

CIRCLE 236 ON READER-SERVICE CARD FOR MORE INFORMATION

**Power Supply  
Magnetic Amplifier**



Model 32V15A, a new magnetic amplifier type low voltage-high current power supply, has a closely regulated tolerance at 15 amp; output is continuously

variable from 5 to 32 v without switching. Regulation is rated at  $\pm 1\%$  from no load to full load, and  $\pm 1\%$  from 105 to 125 v input. Output ripple voltage is not over 1 per cent rms @ 32 v and full load, and not over 2 per cent @ 5 v and full load.

Oregon Electronics, Dept. ED, Portland 15, Ore.

CIRCLE 238 ON READER-SERVICE CARD FOR MORE INFORMATION

**Mobile Recording System  
8-Channel Oscillograph**



Space-saving compactness and mobility are two features of a new 8-channel oscillographic recording system. Completely self-contained, the Model 158-5490 system is designed primarily for recording analog computer outputs, but may also be used for other types of recording. Over-all, the new system measures only 46-1/2 in. high, 27 in. deep and 22 in.

wide. All amplifier and recorder controls are mounted on top of the cabinet. Push-pull or single-ended input signals are fed into miniaturized, dual-channel dc amplifiers of current feedback design. System features include 0.1 v/cm sensitivity; overall linearity of 0.25 mm over entire 4 cm of chart; drift less than 0.5 mm per hour; 5 meg input impedance (each lead to ground); flat frequency response to 20 cps, down 2 db at 60 cps for all amplitudes 4 cm peak-to-peak; nine chart speeds from 0.25 mm/sec to 100 mm/sec; true rectangular coordinate recording.

Sanborn Co., Dept. ED, 195 Massachusetts Ave., Cambridge 39, Mass.

CIRCLE 239 ON READER-SERVICE CARD FOR MORE INFORMATION

**TECHNIC  
Soluble  
GOLD**

**TECHNIC  
Soluble  
RHODIUM**

Technic solutions, like Technic advisory service, set the standards for precious metal electroplating.

**TECHNIC, INC.**

39 SNOW STREET, PROVIDENCE, R. I.

Jackson 1-4209

Chicago Office:

7001 North Clark St.



CIRCLE 240 ON READER-SERVICE CARD FOR MORE INFORMATION

*precision components pay off in performance*



**THE A. W. HAYDON CO. SPECIAL TIME DELAY RELAY** never gives in to severe vibration, shock or sustained acceleration. Positive detent arrangement maintains time setting under all conditions. Large adjusting knob facilitates changing of time setting. Stepless clutch drive minimizes clutch error.

**SPECIFICATIONS**

- \*Voltage Range: 24-29 Volts DC at 60°F.
- Accuracy over Calibrated Range of adjustment:
  - $\pm 0.1$  second or  $\pm 1\%$  of setting, under condition 1.\*
  - $\pm 0.15$  second or  $\pm 2\%$  of setting, over wide temperature range.
- Meets Military Specs. for temperature, altitude, sand and dust, fungus, salt spray, radio filtering.
- Vibration: 5-55CPS with total excursion 0.060".

Current ratings at 29 Volts and room temperature:

- |                           |                             |                                   |
|---------------------------|-----------------------------|-----------------------------------|
| 1. Motor—<br>25 Milliamps | 2. Clutch—<br>200 Milliamps | 3. Contacts—<br>1.0 Amp inductive |
|---------------------------|-----------------------------|-----------------------------------|

Time delay period can be adjusted in 2/10 second increments over range of 0.2—30 seconds.

PREFERRED WHERE PERFORMANCE IS PARAMOUNT



CIRCLE 241 ON READER-SERVICE CARD FOR MORE INFORMATION

Write today for your free copy of this Technical Paper.

ask for data file

**905**

**A Precise, Wide-band, Continuously Variable Delay Line**

BY NORMAN GAW, JR.  
AND DAVID SILVERMAN  
*Helipot Corporation*  
MELVIN B. KLINE  
*Instrument Division*  
Allen B. DuMont Laboratories, Inc.

Presented at THE 1954 WESCON

436



*Helipot Corporation / Newport Beach, California*

a division of BECKMAN INSTRUMENTS, INC.

CIRCLE 237 ON READER-SERVICE CARD FOR MORE INFORMATION

**SHAKEPROOF®  
AUTOMATIC  
POWER SCREW DRIVER**

- New Model "400" can drive up to 60 hopper-fed screws per minute!
- Ideal for automation as well as conventional mass-production assembly lines!

Write for this today!

Model "400"  
Catalog Flyer

**SHAKEPROOF**

"Fastening Headquarters"®

2501 N. Keeler Avenue, Chicago 39, Illinois  
Offices in Principal Cities

**SHAKEPROOF** → Divisions of Illinois Tool Works  
**FASTEX**

CIRCLE 243 ON READER-SERVICE CARD FOR MORE INFORMATION

**How to select  
a Thermistor**

Fenwal Electronics has just completed a comprehensive catalog on thermistors. It tells what thermistors are; what they do; where they are used; and how to select a thermistor for different types of applications. It's comprehensive. It has complete technical data. And it's free.

Fenwal engineers are highly experienced in the manufacture of precision thermistors. Fenwal Electronics produces a complete line of highly stable thermistors in the form of small beads, discs, washers and rods. Because Fenwal thermistors have such a high sensitivity and great stability they are ideal for many applications.

Send for free catalog. Whether you are now using thermistors or not, you'll find it handy to have on file. Write to Fenwal Electronics Incorporated, 51 Mellen St., Framingham, Mass.



Makers of  
Precision Thermistors

CIRCLE 244 ON READER-SERVICE CARD FOR MORE INFORMATION

**Data Recording Camera**

**No Double Exposures**



Designed for technical, industrial, and scientific photographic data recording, an improved model of the Beattie Varitron Model E camera offers efficiency and reliability.

The Beattie Varitron Model E has several new outstanding features: A positive interlock to prevent double exposure regardless of how long the exposure button or mechanism is held, and a new control for even exposure of supplementary data on the negative.

Film magazines for the Varitron Model E accept both daylight and darkroom loading spools of 35 mm and 70 mm film. However, all previous Varitron film magazines may still be used for this new model. An instantaneous shutter and a time exposure shutter both are readily interchangeable and only require plugging into the electrical circuit of the camera. Old style shutters are not interchangeable with these latest type shutters. In addition, the Varitron Model E is now available in 28-v dc.

Photographic Products Inc., Dept. ED, 100 N. Olive St., Anaheim, Calif.

CIRCLE 245 ON READER-SERVICE CARD FOR MORE INFORMATION

**Magnetic Field Measurement**

**Extremely Sensitive**



The Magnatest FM-200 Precision Magnetic Field Meter is an extremely precise instrument for measuring static dc magnetic fields as small as 0.01 millioersted with

an accuracy of  $\pm 1\%$  of the scale reading. With ten ranges, from 1 to 1000 millioersted full scale, the FM-200 is equipped with several different types of probes which expand its usefulness to many applications including both absolute and differential measurements. When used with a recording instrument, the speed of response is on the order of 0.001 second. The new Magnatest Coercive Force Meter (FM-300) has similar characteristics.

Magnaflux Corp., Dept. ED, 7300 W. Lawrence Ave., Chicago 31, Ill.

CIRCLE 246 ON READER-SERVICE CARD FOR MORE INFORMATION

**KESTER  
SOLDERFORMS®**

**BIG STEP** in

**Production Cost-Cutting!**

Take a giant step forward in lowering assembly costs with Kester Solderforms. Labor costs are reduced, assembly operations speeded up. There's no solder waste, and the end result is a neater, more expertly finished product.

WRITE TODAY for complete Kester Solderforms information. Free!

**KESTER SOLDER  
COMPANY**

424 Wrightwood Ave.  
Chicago 39, Illinois  
Newark 5, New Jersey  
Brantford, Canada

CIRCLE 247 ON READER-SERVICE CARD FOR MORE INFORMATION

**New Beryllium  
Copper ROLLPIN**

Now . . . extend the proved advantages of Rollpin to a wide variety of applications where resistance to corrosion, good electrical properties and nonsparking or nonmagnetic characteristics are required.

Use it as you use carbon steel Rollpins—to replace taper pins, straight pins and set screws; to serve as a rivet, dowel, hinge pin or stop pin—to cut production costs by eliminating special machining, tapping, and the need for hole reaming or precision tolerances. Driven into a hole drilled to normal production standards, Rollpin locks securely in place, yet can be readily drifted out and reused whenever necessary. Beryllium Copper Rollpins are available from .062"-diameter to .250".

For all the information you need, write Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, New Jersey, Dept. R36-957.



ELASTIC STOP NUT  
CORPORATION OF AMERICA

CIRCLE 248 ON READER-SERVICE CARD FOR MORE INFORMATION

**Cool that  
Electronic  
Cabinet**

**USE McLEAN  
CABINET COOLING FANS**

Now for the first time, a rack mounted, self contained unit is offered for cooling electronic cabinets. Choice of two fans or blowers mounted side by side, providing maximum filtered air with minimum panel height. Specially designed to fit standard 19" racks. This unit pressurizes cabinet with filtered air, keeping dust out. Complete in one unit and ready for use. No cutting or fitting necessary. Smart stainless steel grille adds beauty and eliminates matching of cabinet finish. Available in two sizes. See specifications below.



Small Size: (7" high x 19" wide with 5 1/2" fan blades or 4 1/2" blower wheels) Delivers 250 CFM  
Large Size: (10 1/2" high x 19" wide with 8" fan blades) Delivers 600 CFM

Also a Complete Line of Industrial Fans—Send for Literature on These and Other Models

**McLEAN ENGINEERING LABS.**  
PRINCETON, NEW JERSEY



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**YOU GET QUALITY +  
... in SODECO IMPULSE COUNTERS**



Whatever your counting problems, you'll find there are SODECO Electrical Impulse Counters to solve them.

Where a large number of machines or equipment must be kept under observation and control, SODECO small, remote impulse counters with zero resetting may be the answer. They are fast—count up to 25 impulses/sec. Touch the small toggle on the front and the counter resets instantaneously. Their low power demands make them suitable for use in electronic circuits. Compactness of design makes them suitable for flush mounting.

When you want an electrical reset, you'll find SODECO Instantaneous Electrical Reset Counters will do the job. They reset remotely—instantly. And they're fast—count up to 25 impulses/sec. Compact—can be flush mounted.

Or, if you need a counter for preselected counting you can get a SODECO to fit. They are fast and provide tamperproof preselection. Separated registers provide for easier reading. Manual, Electric or Automatic Reset. Low power demands of 0.8 to 3 watts.

You can always count on SODECO Counters.  
Write for detailed information.

**LANDIS & GYR, INC.**

45 West 45th Street

New York 36, N. Y.

CIRCLE 251 ON READER-SERVICE CARD FOR MORE INFORMATION

**Circuit Tester  
Localizes Intermittents**



The "Monitron" is for testing electronic equipment where the output signal does not energize a sound producing indicator. It provides a means for sounding an alarm (audio

tone) in case of a break in the signal path, thus enabling the monitoring of signal paths without requiring the constant attention of a technician. At the same time, a dual electron ray indicator tube continues to monitor the signal level independently of the alarm circuits, and an indicator lamp also lights in the channel under test in which the failure occurs.

The "Monitron" can be used to trace signals and localize intermittent problems on any steady signal carrying circuit, whether it be a receiver, transmitter, or similar device. Four major ways to employ the instrument include: monitoring a circuit without attention; monitoring two different circuits simultaneously, tracing signal paths; and making point-to-point gain measurements.

Seco Manufacturing Co., Dept. ED, 5015 Penn Ave. South, Minneapolis, Minn.

CIRCLE 252 ON READER-SERVICE CARD FOR MORE INFORMATION



**NEW AMPLIFIER SAVES SPACE**

A new plug-in d.c. amplifier section offered by Brush permits more compact, flexible, multi-channel recording systems. Six complete interchangeable amplifier sections, plus power supply, plus six-channel oscillograph now can be mounted in a table-top console only 29 1/2 inches high. The amplifier features a unique internal calibration system, and has frequency response from d.c. to 100 cycles.

For complete information write Dept J-9.

**BRUSH ELECTRONICS COMPANY**

3408 Perkins Avenue, Cleveland 14, Ohio



CIRCLE 253 ON READER-SERVICE CARD FOR MORE INFORMATION

Engineers / ME, EE

**RADIO DESIGN**

General Electric's expanding Radio Receiver Department offers to qualified engineers interesting and well-paying career work.

We are looking for technical leadership in the mechanical design area. This Design Engineer should be experienced in mass production methods of consumer goods; have a knowledge of printed circuits, stamped metal parts, dial drive mechanisms and molded plastic parts.

Also opening for Electrical Engineer—an electronics option man—interested in Radio Receiver design.

Excellent developmental and training programs. Tuition Refund Plan for graduate study and other notable benefits. You'll be working in Utica, New York, located near the vacation heartland of upper New York State. Relocation expenses paid. High starting salary.

Please Send resume in confidence to:

Mr. R. P. Stitt  
Radio Receiver Department

**GENERAL ELECTRIC**

869 Broad Street, Utica, New York

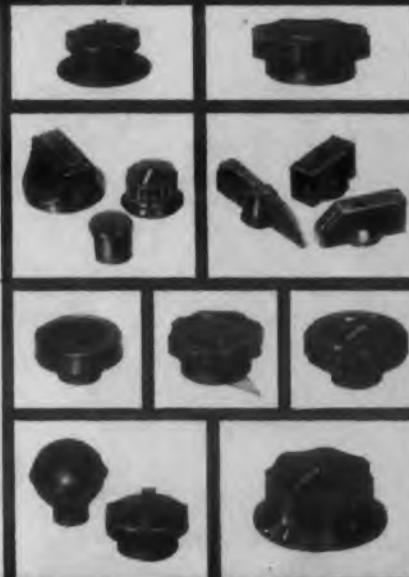
No Fooling  
with Tooling

Instrument and Control  
Knobs—PRICED RIGHT

High quality—  
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ard parts

Hard finish ther-  
mosetting plastic.  
Available fast—  
often from stock

Many more de-  
signs than shown  
—complete size  
range in most



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**KURZ-KASCH, INC.**

Standard Parts Division  
1422 S. Broadway, Dayton 1, Ohio

CIRCLE 255 ON READER-SERVICE CARD FOR MORE INFORMATION

now... extremely long life!

TWENTY  
MILLION

snap-actions—yet  
no bigger than a paper clip!

**LICON\***

TYPE 11 SNAP-ACTION SWITCH

This new Licon precision snap-action switch design eliminates dead break and provides much greater overload capacity. Constructed to military and industrial standards, it can be obtained in a wide differential movement range from .008 to .030. Licon Type 11, a high electrical capacity snap-action switch, is extremely compact... perfect for use where size and dependability are important. Meets MIL S-6743 specifications. Write for Bulletin.

**ILLINOIS**

**LICON**

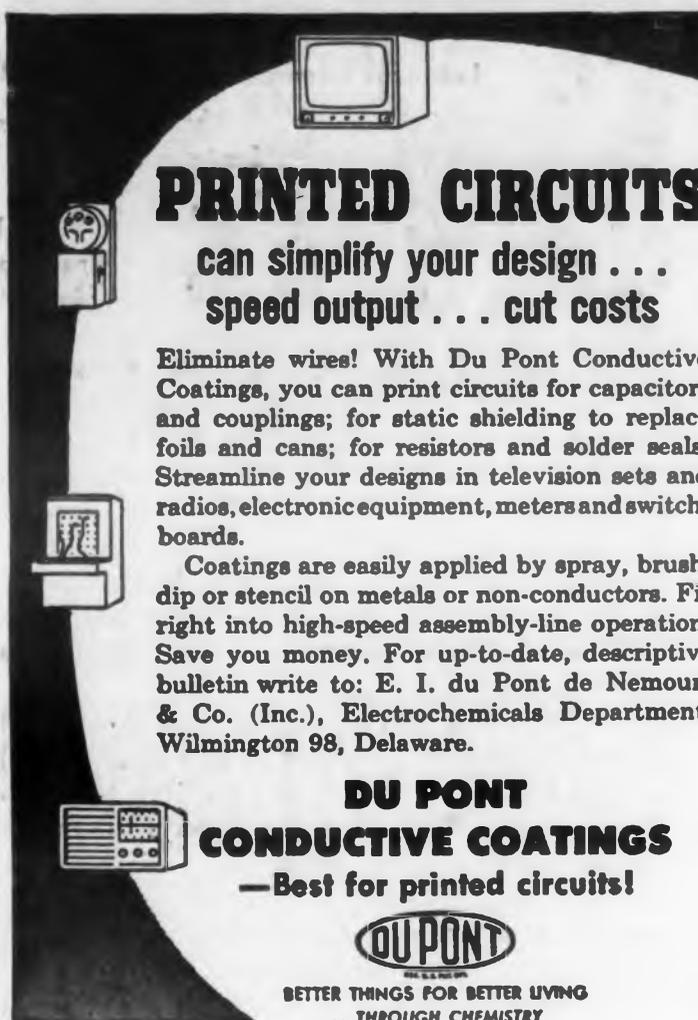
SWITCH AND CONTROL DIVISION

**TOOL WORKS**  
Metal Cutting Tools, Gear Finishing  
and Measuring Machines  
and SHAKEPROOF® Fastenings

2501 N. Keeler Ave Chicago 39, Illinois

\*Trade-mark

CIRCLE 256 ON READER-SERVICE CARD FOR MORE INFORMATION



## PRINTED CIRCUITS

can simplify your design . . .  
speed output . . . cut costs

Eliminate wires! With Du Pont Conductive Coatings, you can print circuits for capacitors and couplings; for static shielding to replace foils and cans; for resistors and solder seals. Streamline your designs in television sets and radios, electronic equipment, meters and switchboards.

Coatings are easily applied by spray, brush, dip or stencil on metals or non-conductors. Fit right into high-speed assembly-line operation. Save you money. For up-to-date, descriptive bulletin write to: E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Department, Wilmington 98, Delaware.

**DU PONT**  
**CONDUCTIVE COATINGS**  
—Best for printed circuits!



BETTER THINGS FOR BETTER LIVING  
...THROUGH CHEMISTRY

CIRCLE 257 ON READER-SERVICE CARD FOR MORE INFORMATION

## This worker can help you cut rejects in winding

This technician and her co-workers check the quality of all raw materials received at Anaconda mills. Only after they are sure that Anaconda's rigid raw materials specifications are met is the material released for production.

This same rigid control is exercised over Anaconda Magnet Wire throughout its entire manufacture—even into shipping.

The result is the finest magnet wire on the market today. A production run will show you how this insistent demand for quality pays off in your winding room — in fewer rejects, longer break-free runs. Many customers are able to eliminate incoming inspection, too.

The Man from Anaconda will be glad to cooperate. Offices in 27 cities — see "Anaconda" in your phone book. Or write: Anaconda Wire & Cable Company, Magnet Wire Headquarters, Muskegon, Michigan.

58C20B

SCHEDULE A

PRODUCTION RUN OF **ANACONDA®**

QUALITY-CONTROLLED MAGNET WIRE

CIRCLE 258 ON READER-SERVICE CARD FOR MORE INFORMATION

## Centrifugal Blower

60 CFM Air Delivery



This centrifugal blower is designed to meet the latest demands for cooling electronic components where higher back pressures have become a problem.

The blower itself resembles the Standard No. 2-1/2 blower with maximum dimensions of

3-7/8 by 4-3/8 in. It can be furnished with motors built to applicable government specifications operating from 115 v, single or 3-phase, 60 or 400 cy, and 24 v d-c. Typical air delivery is 60 CFM against 4" S.P., when driven by a 4-pole cycle motor at 11,000 rpm.

American Electric Motors, Div. of American Electronics, Inc., Dept. ED, 655 W. Washington Blvd., Los Angeles 15, Calif.

CIRCLE 259 ON READER-SERVICE CARD FOR MORE INFORMATION

## Magnetic Switch

Eyes Assembly-Line



A "magnetic detective," to locate objects containing iron on assembly lines, in liquids and even the moving parts of automatic machine tools, has no moving parts. Detection is accom-

plished by the object's passing through a magnetic field set up directly in front of the switch's sensing end.

In assembly-line operations, the switches program the operations as the metal part moves from one station to another. Any break in the sequence is immediately detected and generally shuts down the line until the cause can be determined and corrected.

The new switch, 6 in. long and 1-5/8 in. sq, is sheathed in a heavy steel housing. The magnetic circuitry is embedded in a solid plastic solution. The switch sensing poles are designed to detect metal objects within 1/8 in. of its face. In the case of machine tool operation, the new switch cannot be set off by falling metal chips. It operates on 60 cy, 115 v ac.

Minneapolis-Honeywell Regulator Co., Doelcam Div., Dept. ED, 1400 Soldiers Field Rd., Boston, Mass.

CIRCLE 260 ON READER-SERVICE CARD FOR MORE INFORMATION

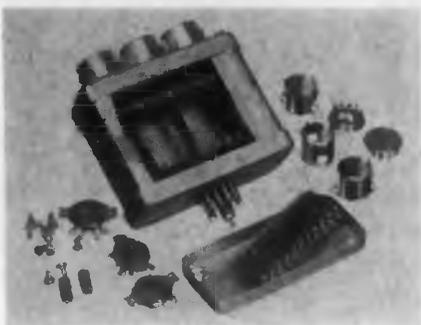


LABORATORY TECHNICIAN carefully measures quality of sample of enamel before it is allowed on the production floor. Results of these tests are recorded and checked against rigid specifications.

## Plug-in Kits

### Take a Variety of Assemblies

These flexible assembly kits provide readily wired packages utilizing "Lip-Loc" cases and "Deck - Turrets" which may be arranged to mount various circuit assemblies.



For example, Kit 4-EK3, with its accessories, may be set up to mount one to three miniature sockets (either 7 or 9-pin) in any order, using adapter rings to accommodate different socket diameters. Socket holes are 3/4 in. diam with slots for saddle screws. 7 or 9-pin sockets are supplied, and also an equal number of JAN type shield bases of each type. Plug buttons are supplied to close socket holes where tubes are not required. An extra un-drilled base is supplied so that larger plugs, such as the "Blue-Line" may be mounted. This kit is assembled with two decks with "Zip" terminals, 9-pin sockets, and an 11-pin octal type plug-in case. One extra third deck is supplied as a loose part which may be inserted in the stack if desired. Overall height of 3, 4, and 5 socket plug-in units is 3 in.

Vector Electronics Co., Dept. ED, 3352 San Fernando Rd., Los Angeles 65, Calif.

CIRCLE 262 ON READER-SERVICE CARD FOR MORE INFORMATION

## Miniature Silicon Rectifiers

### High Temperature Application

Designated the "TJ-A" miniature rectifier series, these hermetically sealed miniature silicon rectifiers have peak inverse voltage ratings from 50

to 400 v. They have maximum forward current ratings of 200 ma at 150 C. The lead-mounted construction enables easy printed board or terminal board mounting.

Two type TJ-40A miniature rectifiers in a full-wave center tapped circuit, with capacitor input filter, can deliver 200-v dc at up to 400 ma continuously at 150 C ambient temperature.

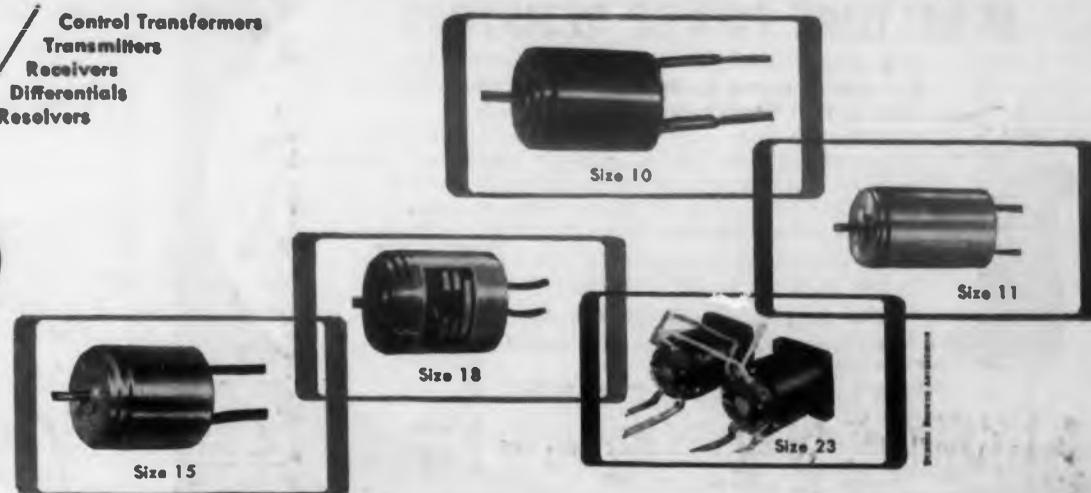
Transistron Electronic Corp., Dept. ED, Melrose 76 Mass.

CIRCLE 263 ON READER-SERVICE CARD FOR MORE INFORMATION

# SYNCHROS

## TO YOUR EXACT SPECIFICATIONS

AVAILABLE AS / Control Transformers  
Transmitters  
Receivers  
Differentials  
Resolvers



TYPE SYNCHRO	SIZE	OSTER TYPE	Frequency C.P.S.	Input Rotor Volts	Input Rotor Amps	Input Rotor Watts	Output Stator Volts	Input Stator Volts	Input Stator Amps	Input Stator Watts	Output Rotor Volts	Rotor Resistance Ohms	Stator Resistance Line to Line Ohms	Null Voltage	Angular Accuracy Maximum Spread
Control Transformer	10	3G-4055	400	26	0.030	0.30	11.8	11.8	0.060	0.20	21.3	160	45	0.050	30'
Control Transformer	10	3G-4079	400	26	0.008	0.10	11.8	11.8	0.018	0.10	20.3	510	200	0.050	30'
Transmitter	10	3G-4075	400	26	0.180	1.4	11.8	-	-	-	-	25	11	0.070	30'
Receiver	10	3G-4059	400	26	0.180	1.4	11.8	-	-	-	-	25	11	0.070	1 1/2°
Differential	10	3G-4071	400	-	-	-	-	11.8	0.070	0.30	11.8	90	45	0.050	30'
Resolver	10	3G-4063	400	26	0.033	0.40	11.8	11.8	0.050	0.20	18.0	235	42	0.050	30'
Resolver	10	3G-4067	400	26	0.011	0.10	11.8	11.8	0.018	0.10	20.3	450	165	0.050	30'
Control Transformer	11	2C-4105	400	26	0.040	0.030	11.8	11.8	0.085	0.19	22.5	91.5	14.2	0.050	20'
Transmitter	11	2C-4125	400	26	0.150	0.80	11.8	-	-	-	-	20	4.3	0.050	20'
Transmitter	11	2C-4123	400	26	0.230	1.0	11.8	-	-	-	-	10.3	4.0	0.070	20'
Control Transformer	15	2G-4005	400	26	0.065	0.40	11.8	11.8	0.150	0.40	21.4	40	10.2	0.050	15'
Transmitter	15	2G-4025	400	26	0.225	1.25	11.8	-	-	-	-	9.5	3.8	0.070	20'
Receiver	15	2G-4009	400	26	0.10	0.45	11.8	-	-	-	-	16	6.7	0.070	45'
Differential	15	2G-4021	400	-	-	-	-	11.8	0.325	0.9	11.8	-	-	0.040	20'
Differential	15	2G-4041	400	-	-	-	-	11.8	0.120	1.3	11.8	14	10.2	0.050	15'
Resolver	15	2G-4017	400	26	0.014	-	18.0	18.0	0.015	-	21	239	180	0.050	40'
Transmitter 12 Power	18	3H-3309	400	26	0.77	2.3	11.8	-	-	-	-	1.032	0.675	0.050	20'
Differential	18	3H-3301	60	-	-	-	-	90	0.070	2.0	90	730	385	0.125	24'
Transmitter	23	3J-4222	60	115	0.120	3.2	17.0	-	-	-	-	140	8.3	0.050	30'

MANY OTHER VARIATIONS AVAILABLE. YOUR DETAILED SPEC GOVERNS:

Angular accuracy  
Impedance  
Transformation ratio

Input and output  
Phase shift  
Humidity treatment

Fungus treatment  
Mil specs to be met  
Operating temperature range

Consult Oster specialists on your synchro problems today.

Other products include Actuators, Servos, AC Drive Motors, Servo Mechanism Assemblies, DC Motors, Motor-Gear-Trains, Fast Response Resolvers, Servo Torque Units, Reference Generators, Tachometer Generators, Motor Driven Blower and Fan Assemblies and Synchro Indicators.

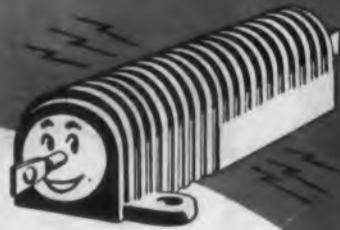
MANUFACTURING CO.  
Your Rotating Equipment Specialist

Avionic Division  
Racine, Wisconsin

CIRCLE 264 ON READER-SERVICE CARD FOR MORE INFORMATION

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You can depend on



## TYPE RH MINIATURE POWER RESISTORS

For all applications where the equipment must survive the most severe environmental, shock, vibration, humidity and temperature conditions.

Smallest in size; completely welded from terminal to terminal; silicone sealed in a die-cast black anodized aluminum housing and mounts on sub-panel for maximum heat dissipation; impervious to moisture, salt ions, vapor and gases.

Three wattage ranges: RH-25, 25 watts;  
RH-50, 50 watts; RH-250, 250 watts.

- Temperature coefficient 0.00002/Deg. C
- Ranges from 0.1 ohm to 55,000 ohms, depending on type
- Tolerances 0.05%, 0.1%, 0.25%, 0.5%, 1%, 3%, 5%



Conform to applicable JAN and MIL Specifications

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CIRCLE 266 ON READER-SERVICE CARD FOR MORE INFORMATION



**dual D-B power supply**  
—six outputs; close  
regulation; only 8¾" high

DRESSEN-BARNES  
Model D3-500B

#### Output Voltages:

1. Dual 0-300 V.D.C. continuously variable without switching. Outputs are floating—either plus or minus may be grounded. Current: 0-500MA max.
2. Dual bias voltages: —300 V.D.C. fixed. Current: 0-2 MA max.
3. Dual external 6.3 V.A.C. @ 10 amps.

#### Regulation:

For 300 v. output: 100 MV change NL to FL. For line voltage of 115 V.A.C.  $\pm 10\%$ , the voltage change is 0.15%.

Ripple—below 2 MV. RMS for any voltage or load within rating.

Recovery Time—NL to FL: 0.4 milliseconds. FL to NL: 0.1 millisecond. 1 volt max. transient.

This compact unit gives you two 0-300 volt outputs... two bias outputs, and two A.C. outputs. Note the excellent regulation... the low ripple and fast recovery. Unit is a true dual—each half is independent of the other. Only 8¾" high, 19" wide, 17" deep. Request literature on Model D3-500B.

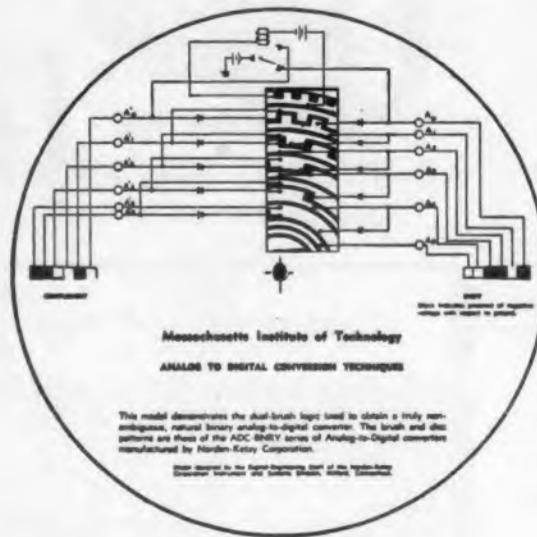
Also available as single unit.  
Model 3-500B

**dressen-barnes**

DRESSEN-BARNES CORP., 250 N. Vinedo Ave., Pasadena 8, Calif.

CIRCLE 267 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Literature



This model demonstrates the dual-brush logic used to obtain a truly non-ambiguous, natural binary analog-to-digital converter. The brush and disc patterns are those of the ADC-BNRY series of Analog-to-Digital converters manufactured by Norden-Ketay Corporation.

### Free Analog To Digital Conversion Chart

268

This chart demonstrates the dual-brush logic used to obtain a truly non-ambiguous, natural binary analog-to-digital converter. The brush and disc patterns are those of the ADC-BNRY series of Analog-to-Digital converters manufactured by Norden-Ketay Corp., 99 Park Ave., New York, N. Y.

Designed by Ken Bacon of the Digital Engineering Staff, Instrument and Systems Div., requests will be honored for a free copy of this circular slide chart.

### Perforated Metals

269

A new 6-page brochure has been made available describing a line of industrial and decorative perforated metal sheets. Included are information as to sheet sizes, type and gage of metal, and percent of open area. Perforated patterns are illustrated at actual size.

The Harrington & King Perforating Co., Inc., 5655 Fillmore St., Chicago, Ill.

### Mechanical Tubing

270

A data sheet has been issued on tolerance tables and additional size ranges for square, rectangular and round carbon and stainless steel welded mechanical tubing.

Wall, desk and pocket type charts list the tube, wall and cut length tolerances for hot and cold rolled carbon and stainless steel tubes, in addition to weight and chemical analyses.

Specifications are in tabular form mounted charts.

Steel and Tubes Div., Republic Steel, 224 E. 131st St., Cleveland 8, Ohio.

### Rectifiers

271

A selection chart, ETD-1322, has been released listing the essential characteristics of 75 power rectifiers and control tubes available. The chart classifies 46 thyratrons according to type, lists anode and cathode current and voltage ratings, and gives the average control characteristics of each tube. Twenty-nine ignitrons are listed according to classification: welding-control tubes, frequency-changer welding tubes and power rectifier tubes.

General Electric Tube Sales, 1 River Rd., Schenectady, N. Y.

### Laminated Sheets

272

Recently published is a 12-page, 2-color catalog containing information on the manufacture of laminated sheet, wire and tubing for industrial use. Comparative tables of weight and other technical information are in the catalog.

The Improved Seamless Wire Co., 775 Eddy St., Providence, R. I.

## Transmitting Materials

276

A 4-page brochure provides information on 15 different infrared transmitting materials suitable for use as optical elements. Transmission curves are included for the eleven most important materials.

A key factor in the design of infrared equipment is the bandwidth of infrared transmission accepted by the transducer components. Since optical elements are generally critical portions of the infrared system, they must transmit infrared in the proper bandwidth as well as meeting other chemical, physical and mechanical requirements.

Servo Corp. of America, New Hyde Park, N. Y.

## Metal Ateenate Process

277

A 5-page bulletin has been released describing a new process for producing permanent jet black markings on stainless steel. The bulletin gives resistance qualities, material, color, and other information of interest to engineers.

Photo Chemical Products, 470 Walton Ave., New York, N. Y.

## Services and Facilities

278

A 72-page bulletin covering services and facilities has recently been published. This bulletin contains more than 70 photographs and covers typical measurements and determinations made on hundreds of products and materials. In addition, it catalogs laboratory equipment available for limitless assignments in the fields of testing, applied research, and engineering analysis. This information is subdivided into the areas of chemical, electrical, electronic, mechanical and physical, and photometric, radiometric, and colorimetric testing.

Electrical Testing Labs., Inc., 2 E. End Ave., New York 21, N. Y.

## Power Supply

279

A new bulletin has been made available describing Model M562 strain gage power supply, 5 v at 1 amp continuous. The bulletin features specifications and applications, as well as an outline dimensional drawing of the unit.

Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.



Introducing...  
the *New Look*  
in Laminated  
**TUBING**

**TUFF-TUBE** 

**fiberglass-epoxy tubing**

Especially designed to solve ever-increasing insulation and other problems for the electronics industry, TUFF-TUBE combines all the desirable features of fiberglass-epoxy with the exclusive new Lamtex impregnation and curing process.

TUFF-TUBE can help you in dozens of applications calling for *any combination* of critical requirements: electrical properties, high temperatures, dimensional stability, low moisture absorption, corrosion resistance, light weight, strength.

- WAVEGUIDES
- COIL FORMS
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- Uniform thin walls, down to .008"
- All shapes and sizes, down to .062" ID
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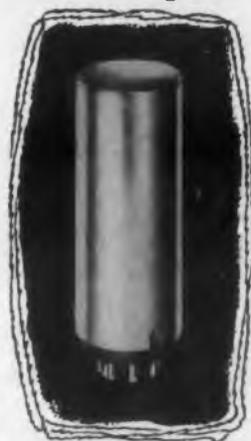
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For Maximum Frequency Control



**JKTO**  
**TRANSISTOR**  
**CRYSTAL OSCILLATORS**

Dimensions: 1.26" dia.  
by 3.75" seated height

Frequency Range: 1 kc to 25 mc  
(higher available)

Frequency stability: (24 hour period)  
1 part in 10<sup>6</sup> or better at 50 kc up

Supply voltage: Heater  
6V to 115V ac or dc

THE JAMES KNIGHTS COMPANY—Sandwich, Illinois



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**Electroplated WIRE**

More and more people are turning to us for electroplated wire. We electroplate by continuous methods a wide variety of wire in a range of diameters from .035" to the smallest available. In our laboratory, Tungsten wire as small as .00015" has been electroplated with Gold... New applications for electroplated wires on different base materials are being developed from time to time...

Your inquiry is invited. Consult our staff, without obligation, about your specific wire problems.

Specialists in the Unusual

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CIRCLE 282 ON READER-SERVICE CARD FOR MORE INFORMATION

# KODAK COLOR PRINTER

USES



## LOGARITHMIC POT FOR PRECISE

EXPOSURE  
TIMING



An important requirement in the design of the precision Kodak Color Printer, Model 1599C, is its highly accurate electronic exposure timing device. Rigid specifications set by Eastman Kodak Co. engineers for a precision 6:1 ratio logarithmic potentiometer were met by TIC—specialists in the design of non-linear function potentiometers.

TIC manufactures standard 50 db and 20 db logarithmic potentiometers of high resolution and high conformity. The unique double-contoured resistance-element card makes possible the high accuracy of all TIC non-linear potentiometers. This card design (contoured symmetrically on both edges) also permits greater flexibility in the design of non-linear functions—flexibility required for special designs like the pot used in the Kodak Color Printer.

Low temperature coefficient of resistance . . . high resolution . . . complete environmental protection . . . and precision mechanical construction add to the high conformity and reliability of TIC non-linear potentiometers. As leaders in the field, TIC design experience can help you in selecting a non-linear pot, standard or special, for your application.

Complete specifications on TIC non-linear potentiometers available upon request.

## TECHNOLOGY INSTRUMENT CORP.

555 Main Street, Acton, Mass., COLonial 3-7711

West Coast Mail Address, Box 3941, No. Hollywood, Calif., POplar 5-8620

CIRCLE 286 ON READER-SERVICE CARD FOR MORE INFORMATION

### Self-Locking Fasteners 287

Catalog No. 11-B, 12-pages, has been issued showing the complete line of self-locking fasteners. Based on the use of a nylon pellet inserted into the threaded area of fasteners, the pellet locks in any position along the thread, and when removed, the "plastic memory" of nylon makes it return to its original shape, providing great re-usability.

In addition to the standard parts listed, parts may be made to special design. Nylok Corporation, E. 14th and Grand Central Ave., Elmira Heights, N. Y.

### Thermostat Bimetal 288

A 6-page illustrated data sheet containing complete engineering data on a new thermostat bimetal, ASC-3, is now available.

The data sheet, designated Technical Data Sheet No. A-401, contains, in addition to engineering specifications, formulas for thermal deflections, load of force, force-temperature, force-deflection and stress of cantilever, U-shape, and helical elements. Industrial Division, American Silver Co., 36-07 Prince St., Flushing 54, N. Y.

### Subminiature Relay 289

A two-page bulletin, GEA-6412, has been issued describing the 2PDT hermetically-sealed subminiature relay. The two-color publication describes the addition to the company's line of hermetically-sealed relays; and lists the relay's operating advantages. The bulletin also provides a table of technical data on the operating characteristics of the relay along with a table of coil data which lists coil voltage, coil resistance, etc.

General Electric Co., Schenectady 5, N. Y.

### Laminated Tubing 290

A 4-page illustrated brochure describing TUFF-TUBE, new laminated fiberglass-epoxy tubing possessing properties is now available. This brochure contains information on high temperature characteristics, electrical properties, weight and strength. Also included is an illustrated section dealing with suggested applications of this material, of interest to designers in the aircraft, electronics, chemical, petroleum, and food industries.

Lamtex Industries, Inc., 51 State St., Westbury, L. I., N. Y.



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Newest in the line of EDCOR adjustable and fixed Polystyrene Decades is the 1 to 10 mfd PS model.

The EDCOR PS Decades maintain high insulation of  $10^6$  meg/mfd, precision up to .1%, long-time stability and the space-saving benefits of precision capacitors combined into a single package. EDCOR PS Decades are widely used in Analog Computers, Filter Designs, Laboratory Standards.



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1323 AIRWAY • GLENDALE 1, CALIF.

Filters • Networks • Comparison Bridges • Decade Boxes • Servo-circuits

CIRCLE 291 ON READER-SERVICE CARD FOR MORE INFORMATION



An 87-page technical manual describing the complete line of electrical indicating instruments and test equipment has been issued.

Illustrated with photographs, wiring diagrams, and dimensional drawings, Manual No. 17 is printed in two colors. Special indexes make instant reference to any product.

The panel meter section combines in a single publication complete descriptions and illustrations of more than 800 different kinds and sizes of panel meters.

Meter movements are illustrated with photographs and exploded views. Simpson Electric Co., 5200 W. Kinzie St., Chicago, Ill.

**VSWR Measuring System**

Pamphlet Form 125-256 has been published describing Band-sweeping equipment for continuous display or recording of VSWR in the region 8500 to 9600 mc for laboratory research. The system is described as the instant-reading, radiometer type.

Color Television Inc., 1070 E. San Carlos Ave., San Carlos, Calif.

**Ultra-Thin Copper**

The ASC Technical Data Sheet TWC-101 is now available describing wrought ETP copper, rolled to record thickness of as low as 0.00017 in. This was produced to meet Air Force requirements for material of superior electrical conductivity properties that would operate at high temperature, occupy appreciably less space, and weigh appreciably less than conventional copper wire. It discusses the advantages of ultra-thin copper tape over aluminum for wafer-coil applications.

American Silver Co., Inc., 36-07 Prince St., Flushing, N. Y.

**Deflection Yokes**

A revised catalog-page has been released describing magnetic deflection yokes for 11-1/2 in. neck diameter military and oscilloscope applications. Complete data includes design features, dimensional drawing, and revised tables listing electrical and mechanical characteristics, push-pull deflection coil data and single-ended deflection coil data.

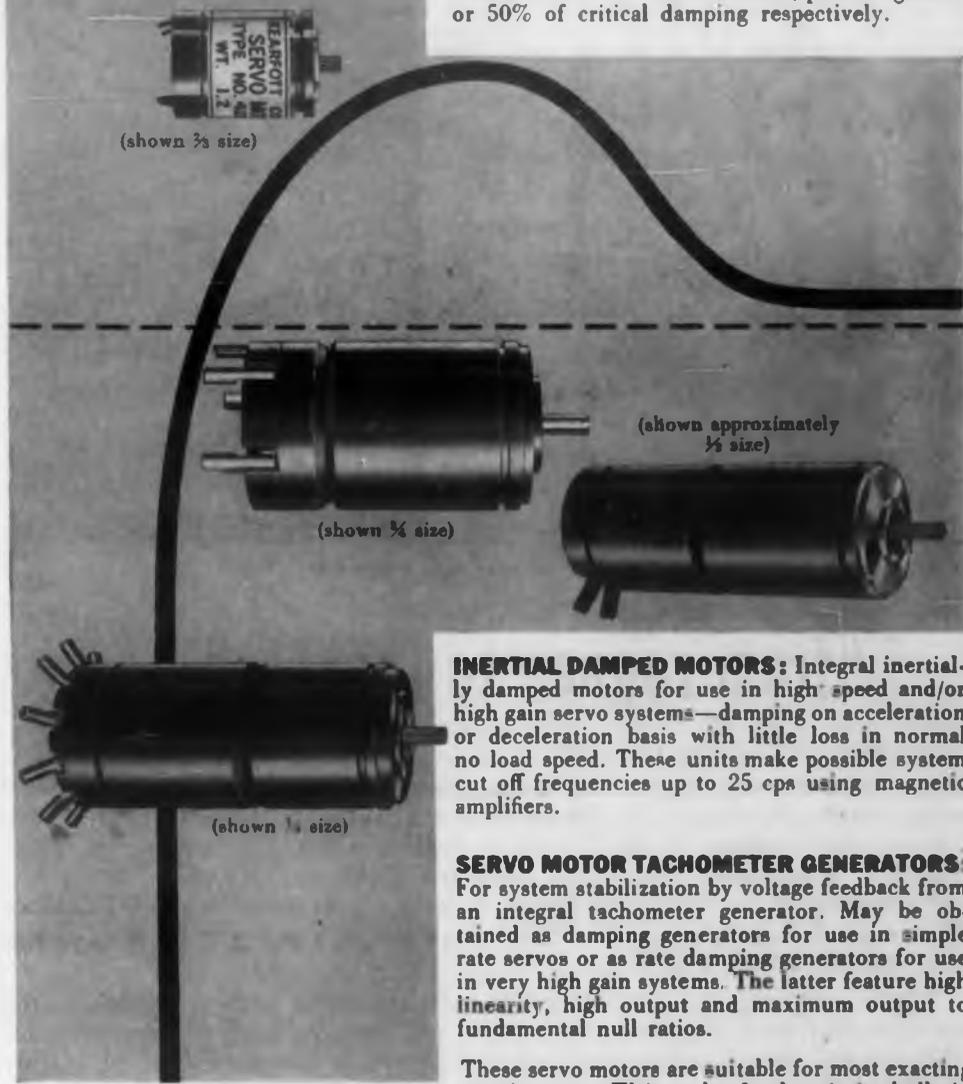
Syntronic Instruments, Inc., 170 Industrial Rd., Addison, Ill.

There is no one "cure all" for system instability. The desired stability of a servo loop is attained through the proper selection of components that satisfy the various conditions under which the loop will operate. Kearfott offers four basic motors and combinations for providing system stability. All feature high speed of response; low inertia and high stall torque.

**SYSTEM STABILITY**

**SERVO MOTORS:** Servo motors with high torque to inertia characteristics possessing (built-in) inherent damping ranging in size from 1/8" to 1 1/2" diameter are available. Low speed, low power motors for use in simple instrument servos where high damping and/or low time constant is required can also be provided.

**VISCOUS DAMPED SERVO MOTORS:** Provide integral viscous damping for simple instrument servos. Any degree of damping can be provided. These units reduce no load speed of standard motors to 50% or 75% of normal, providing 70% or 50% of critical damping respectively.



**INERTIAL DAMPED MOTORS:** Integral inertially damped motors for use in high speed and/or high gain servo systems—damping on acceleration or deceleration basis with little loss in normal no load speed. These units make possible system cut off frequencies up to 25 cps using magnetic amplifiers.

**SERVO MOTOR TACHOMETER GENERATORS:** For system stabilization by voltage feedback from an integral tachometer generator. May be obtained as damping generators for use in simple rate servos or as rate damping generators for use in very high gain systems. The latter feature high linearity, high output and maximum output to fundamental null ratios.

These servo motors are suitable for most exacting requirements. Write today for descriptive bulletin giving data of components of interest to you.

**KEARFOTT COMPONENTS INCLUDE:**

Gyros, Servo Motors, Synchros, Servo and Magnetic Amplifiers, Tachometer Generators, Hermetic Rotary Seals, Aircraft Navigational Systems, and other high accuracy mechanical, electrical and electronic components.



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**1 1/2" RUGGEDIZED METER**

- Meets specification MIL-M-10304 (SIG. C.)
- Barrel: 1" long, 1 1/2" diameter
- Weight: 4.2 ounces
- Special scales and ranges available
- Prompt delivery



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**DATA SHEETS ON:** 1 1/2" Ruggedized Meters; 1" and 1 1/2" Panel Meters; 1 1/2" VU, Db, and Illuminated Meters; Miniature Multitesters, Side Indicators and Sub-Miniature Rotary Switches.



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CIRCLE 299 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE 300 ON READER-SERVICE CARD FOR MORE INFORMATION



ONE OF A SERIES — depicting Weapon Systems — "Yesterday, Today & Tomorrow"

## "from rogues to rockets"...

Benjamin Thompson, Count Rumford — 1783-1814... rogue extraordinary... traitor... turncoat... yet one of the greatest scientist of his time. Founder of the modern science of ballistics, his theories and work on early artillery were the basis of Napoleon's concept of highly mobile artillery units. But starting in 1806, Congreve's rockets with their greater range and power almost replaced artillery... until it was found that rifling the barrel of the big guns gave the needed distance and accuracy. Gradually the rocket took a back seat as a war weapon until it was revived during World War II.

These early weapons contrast against today's intricate weapon systems, as the present products will compare with the even more complex needs of tomorrow. But at Bell Aircraft these complex needs are already well in the planning stage. Highly trained engineering teams are dealing not only with today's problems, but tomorrow's achievements. For the creative engineer seeking top assignments, Bell can offer opportunities leading to a high level of professional achievement—in an engineering department with that young look.

Engineers with experience in the design and development of electronic components including:

Integrators • Computers  
Accelerometers • Transmitters  
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P. O. Box 1 Buffalo 5, N. Y.

### Spot Welder

307

Bulletin 339, completely describing a four function spot welder covering a wide range of aircraft and other rigid welding specifications, has been introduced. This bulletin discusses the various circuits employed with this new type dekatron tube control. Various illustrations and a block diagram, and the four function spot welder is simply and effectively explained.

Included are the various possible combinations of control function for spot and seam welders.

Sciaky Bros., Inc., 4915 W. 67th St., Chicago, Ill.

### Molded Plastics

308

A 17-page bulletin has recently been issued describing molded plastics. Some of the methods of molding, including compression, injection, cold molding and molding of reinforced plastics are discussed in this 3-color illustrated booklet. In addition the booklet contains photographs of various molding operations and descriptive explanations of applications.

American Insulator Corp., New Freedom, Pa.

### Variable Transformers

309

A 22-page catalog, No. A56, has been issued describing the expanded and redesigned line of adjust-A-volt variable transformers in auto, isolated and metered models for bench and panel mounting. All single and ganged units are illustrated and described with photographs, dimension drawings, wiring and circuit diagrams.

A complete specification and application index is also included.

Standard Electrical Products Co., 2240 E. Third St., Dayton, Ohio.

### Selenium Contact Protectors

310

Bulletin "A-B-C" on selenium contact protectors, which explains the operation, uses and advantages of this product, has recently been issued. The bulletin is for use by design engineers and components distributors wanting to know about the selenium protectors which are used to eliminate arcing between contacts in inductive circuits.

Components Div., Federal Telephone and Radio Co., 100 Kingsland Rd., Clifton, N. J.

## Century MODEL 20 VISUAL MONITOR



For TEMPERATURE PRESSURE VIBRATION FLOW  
RADIATION COLORIMETRY CURRENT VOLTAGE

Does your data problem include any of the above? Or anything similar?

The Model 20 Visual Monitor is a completely new concept in multiple data-point indication.

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CIRCLE 311 ON READER-SERVICE CARD FOR MORE INFORMATION

### Microminiature Relay 316

An eight-page bulletin, GEA-6346A, has been published describing hermetically-sealed microminiature relay. The two-color publication provides a detailed description of the lightweight relay for airborne, ship-board, and portable unit applications. Operating features are listed and discussed individually, and a complete table of specifications is included. Photographs of the various types of microminiature relays; coil data table for each model; and technical data on the types of cans and mountings are included.

General Electric Co., Schenectady 5, N. Y.

### Switches 317

A 4-page bulletin has been released describing the propeller feathering system switches, turbo-jet engine starting system switches and generator and inverter circuit switches. The bulletin shows illustrations, technical descriptions and wiring diagrams. Also included are time delay units and torque pressure switches.

Airite Products, Inc., 3516 E. Olympic Blvd., Los Angeles 23, Calif.

### Potting Shells 318

A data sheet on potting shells for several types of its electrical connectors has been announced. Sealing compound, applied in a molded plastic potting shell after wiring the connector contacts, provides complete protection of solder cups and wires. It seals the connector against moisture and prevents cable strain under extreme vibration and repeated connect and disconnect of plug and receptacle. The data sheet illustrates several shapes and sizes.

Electronic Sales Div., DeJur-Amsco Corporation, 45-01 Northern Blvd., Long Island City 1, N. Y.

### Assembly Components Kit 319

A 12-page brochure, TDS 1110, has been published describing Service Units. Three terminal assemblies provide compact termination and convenient test points for all "internal" wiring as well as take-off points for connection of "external" equipment. Two different dial assemblies are available to show the degree of rotation of a shaft. Servo Corp. of America, 20-20 Jericho Turnpike, New Hyde Park, L.I., N.Y.



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Input 117vac Term. No.	Connect Term. No.	Resistive Load		Capacitive Load**		Resistive Load		Capacitive Load**	
		Secondary Volts AC	Output Volts DC	Secondary Volts AC	Output Volts DC	Secondary Volts AC	Output Volts DC	Secondary Volts AC	Output Volts DC
1-2	—	29.4	11.2	28.8	13.8	28.5	23.0	27.9	30.0
1-7	2-6	26.0	9.8	25.7	11.7	25.4	20.0	25.1	26.4
1-6	2-5	23.0	8.4	22.7	9.9	22.3	17.3	21.8	22.2
1-7	2-5	20.9	7.4	20.8	8.6	20.2	15.4	19.8	19.7
1-3	—	19.4	6.7	19.1	7.6	18.6	13.9	18.2	17.6
1-7	3-6	17.8	6.1	17.6	6.7	17.2	12.8	16.8	15.7
1-6	3-5	16.3	5.3	16.1	6.0	15.7	11.2	15.2	13.8
1-7	3-5	14.9	4.7	14.8	5.3	14.3	10.3	14.1	12.4
1-4	—	14.2	4.4	14.2	5.0	13.7	9.7	13.5	11.6
1-7	4-6	13.4	4.0	13.3	4.4	12.7	8.8	12.5	10.4
1-6	4-5	12.4	3.6	12.4	3.9	11.7	7.9	11.7	9.5
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## Soldering Equipment 327

Five illustrated literature sheets have been issued describing soldering equipment. Complete specifications and servicing information are given and the tools are shown in operating position; the Versa-Tool is also shown open for servicing.

Phillips Mfg. Co., Inc., 2816 Aldrich Ave., Minneapolis, Minn.

## Vacuum Capacitors 328

A new specification sheet on high rated variable vacuum capacitors is available. This features rugged construction using glass hulbs, copper seals and cylinders. Included are line drawings and application notes.

VACAP, 1905 Summit Ave., Union City, N. J.

## Data Wall Chart 329

Engineering Data Wall Chart, giving tables on decimal equivalents, temperature conversion, wire size and current ratings, mechanical and electrical conversion tables is now available.

Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.

## Phone Plugs and Jacks 330

The S-57, 28-page catalog has been issued giving detailed information on new products and the company's expanded line. This booklet includes specifications, drawings, schematic circuits and prices on component parts. Products include jacks, plugs, switches, connectors, shielded jacks, cable assemblies, jack covers, and several other component parts.

Switchcraft, Inc., 1328 N. Halsted St., Chicago 22, Ill.

## Wafer-type Coils 331

A data sheet, published on ultra-thin copper for the new wafer-type coils, is now available to electronic and electrical engineers. This data sheet, designated as ASC Technical Data Sheet TWC-101, gives detailed information on mill limits, chemical composition, hardness requirements, and availability. It discusses the advantages of ultra-thin copper tape over aluminum for wafer-coil applications, and gives complete information on how to specify and order this material.

American Silver Co., 36-07 Prince St., Flushing 54, N. Y.

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## Coil Winder

336

A data sheet on the toroid coil winder has recently become available. It describes the method of winding off the inside of the shuttle that makes possible the winding of finished coils having an inside diameter of 3/32 of an inch.

It also contains full specifications of the wide range of wire sizes possible; the full 360° coverage of the core; the high 200 turns per minute winding speeds.

Electro Devices Co., Inc., 580 Main St., Wilmington, Mass.

## 2-Ounce Molding Machine

337

Bulletin 565, recently issued, features the Model 701 2-ounce automatic injection molding machine. Bulletin gives complete specifications for Model 701, and also describes the advisory service for plastics molders which provides them with a detailed cost study on their specific product and enables them to find out what truly automatic injection molding can do for the machines.

F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.

## Development in Infrared

338

Bulletin No. 18 has been issued featuring articles on the subjects of infrared spectroscopy and data processing. The new Beckman "111" data system with its accuracy, versatility and reliability along with "pin-board control" is described. Included is a two-page spread complete with charts and pictures of 10 additional uses for the DK recording Spectrophotometers.

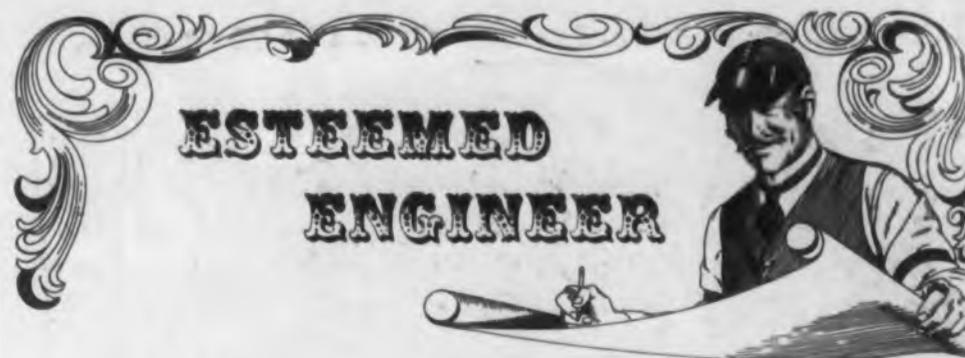
Scientific Instruments Div., Beckman Instruments, Inc., 2500 Fullerton Rd., Fullerton, Calif.

## Packaging Booklet

339

A booklet has been published describing the applications and money saving aspects of the company's Cutter and Crimper. Illustrations are included for the many uses of pre-cut and crimped material, and how they are being employed by various wrapping departments. The booklet describes the operation of the cutter and crimper and pictures a suggested floor plan and packing table arrangement.

Kord-Mar Co., Inc., 204 Lockerbie, Wilmette, Ill.



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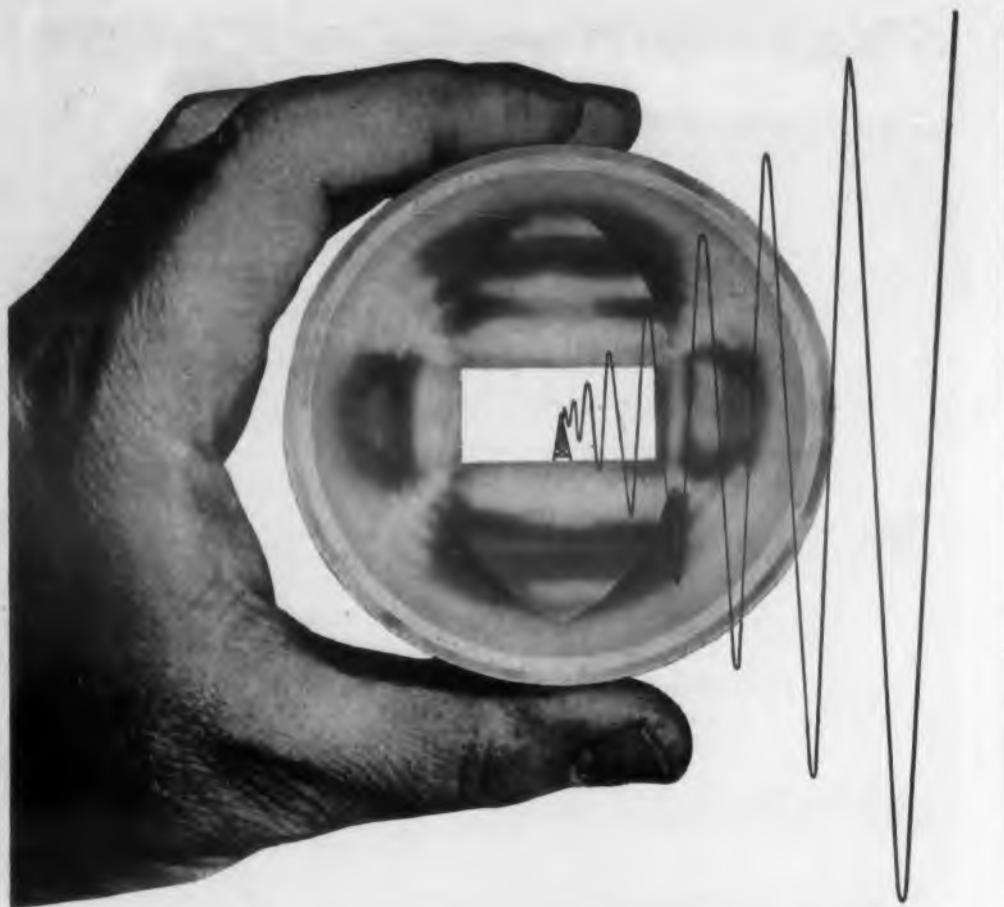
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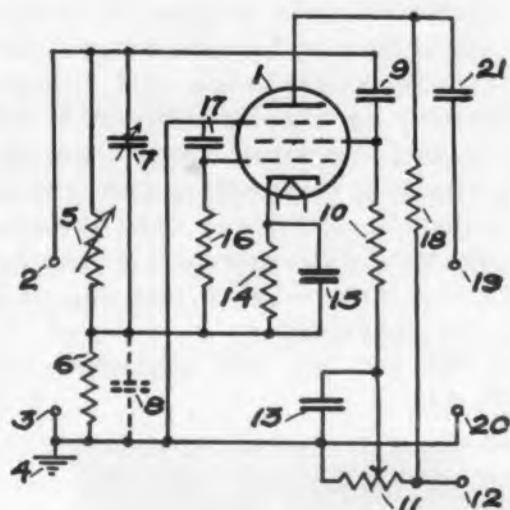


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## Patents



### Grounded Grid Radio Tube Circuits

Patent No. 2,736,777. R. Lambert, Cincinnati, Ohio.

In a circuit using a vacuum tube having a grounded grid and cathode resistor there is a transfer of the signal from cathode to anode which produces a diode effect. This diode effect is objectionable since it is out of phase with respect to the input signal at the grid and causes trouble in radio receiving circuits which use circuit elements for interference degeneration.

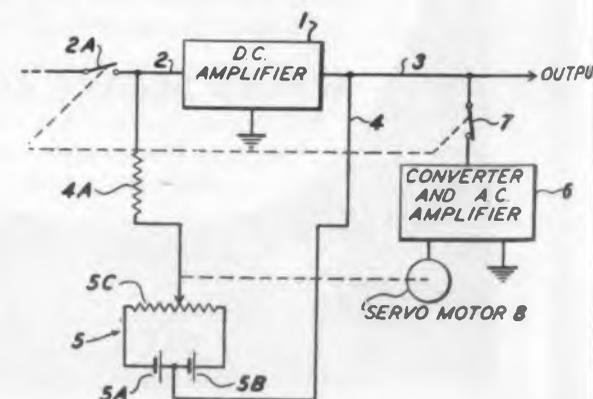
The circuit of Fig. 1 compensates for this diode effect and requires a multiple grid tube, a pentode 1 being particularly shown. The elimination of the diode effect is secured by using a condenser 17 between the control grid and ground and also by using a resistor 5 and shunting condenser 7 of a particular value or adjusted to a particular value in the input circuit. A portion of the input signal developed across the resistor 5 and condenser 7 is applied to the screen grid through condenser 9.

Initially the condenser 17 is connected between the control grid and the cathode and a signal is applied to the input ter-

minals 2, and 3. The resistor 5 and condenser 7 are then adjusted until there is no signal, or silence, across the output terminals 19 and 20. When so adjusted, the condenser 19 is again connected to ground rather than to the cathode and the circuit is compensated for diode effect.

**Device for Automatically and Periodically Correcting the Zero Drift in an Amplifier**  
Patent No. 2,734,949. C. E. Berry (Assigned to Consolidated Engineering Corp.)

In order to control a dc amplifier so that there will be no zero drift, a variable voltage source 5 is provided which is controlled by a converter and ac amplifier 6 connected with the output 3 of the dc amplifier. The ac amplifier energizes a servo motor 8 which adjusts the position of the contact of a rheostat 5C and varies the voltage applied to the input of the dc amplifier. A switch 2A in the input line of the dc amplifier and a switch 7 in the input line of the ac amplifier are ganged, so that when the input switch is opened, the ac amplifier switch is closed to operate the servo motor. This circuit finds particular usefulness in mass spectrometers.



### Rapid Response Self-Saturating Magnetic Amplifier

Patent No. 2,733,306. B. D. Bedford. (Assigned to General Electric Co.)

Magnetic amplifiers, using rectifying means in series with the load and load current control winding of the saturable reactor, experience a difference in the speed of response to signal and transient currents in opposite directions. A magnetic amplifier which does give a rapid response for these signal currents in both directions has advantages. This is particularly true of a full wave form of circuit. The slow response to signal currents in one direction is due to an induction voltage generated in the load windings of the saturable reactor.

The circuit shown in the figure secures a rapid response to signals in both directions by providing a resistor 18 in series with the load winding 16 of the control saturable reactor. Across this resistor a voltage is provided 180° out-of-phase with the voltage in the load circuit by a portion 24 of the transformer secondary 19, or it may be a separate winding. In this shunt circuit there is a rectifier 25 so that current flow in the resistor 18 is in the same direction as load current flow in the load circuit.

With this circuit, when an induced volt-

age is generated in the load winding 16 of the reactor, an opposing potential is set up in the resistor 18 and thereby compensates for the induced voltage. The contact 26 may be adjustable to change the relative proportion of potential in the respective windings 19 and 24. The circuit illustrated is a half-wave circuit; however, the patent also describes full wave circuits.

**Display Surface For Color Television Tube**  
Patent No. 2,745,033. Ernest O. Lawrence. (Assigned to Chromatic Television Lab., Inc., New York)

A display screen for cathode-ray tubes for producing television images in color. The device employs a number of parallel linear conductors for establishing a system of electron lenses adjacent to the display screen. The display screen has a coating of three different phosphors, emissive on electron impact of light of three component colors additive to produce white light. The conductive strips are arranged in a repeating pattern with alternate strips being wider at the end portions than at the central portion, and the intervening strips being wider at the central portions than at the ends.

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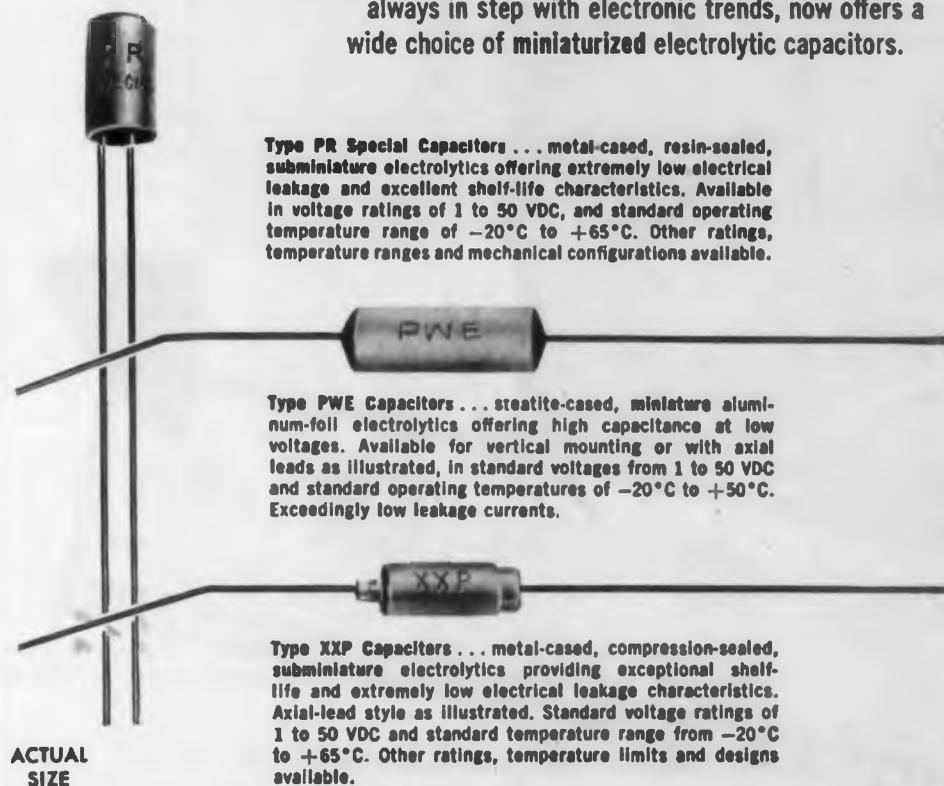
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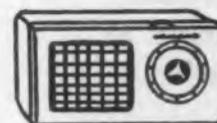
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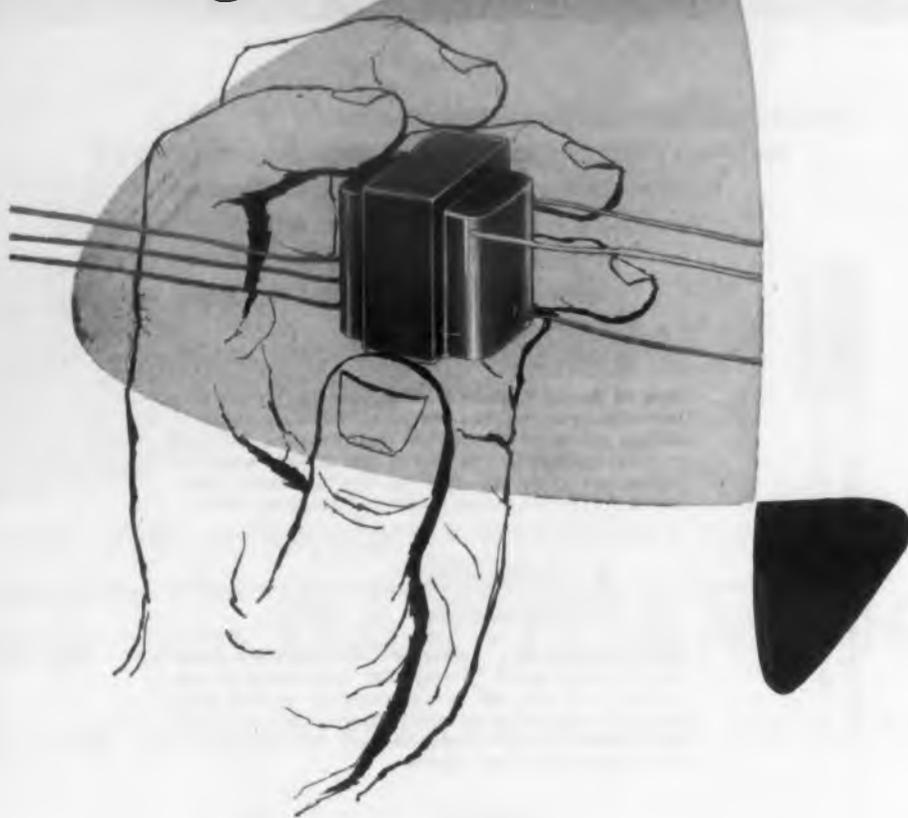
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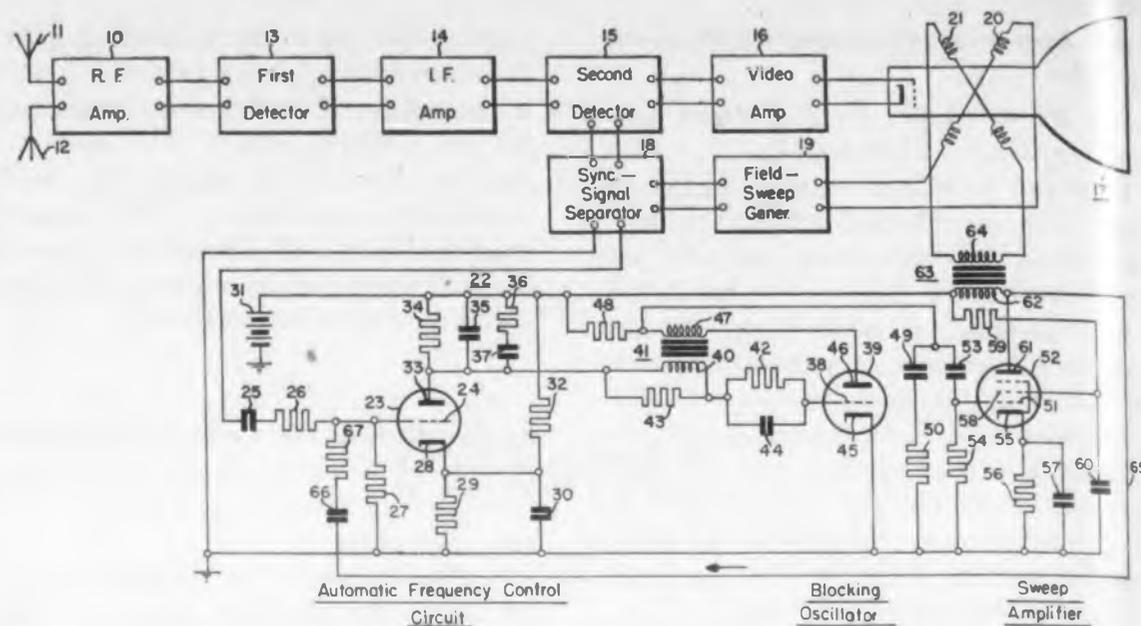
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### Automatic Frequency-Control Circuit

Patent No. 2,732,495. J. E. Bridges. (Assigned to Zenith Radio Corp.)

In television circuits it is essential that the local oscillator be maintained in step with the synchronizing signals carried by the incoming signal. Failure to keep the local oscillator in synchronism results in imperfect images or no image at all on the cathode-ray tube screen. Noise disturbances

in the received signal is the more frequent culprit in causing loss of synchronization of the local oscillator.

The circuit of the figure includes the local oscillator 39 which is adjusted to the proper frequency. The output of the oscillator is amplified by the amplifier 52. The output of the amplifier is coupled to the line sweep coils 21 through the transformer 63 to give a sawtooth wave in the sweep coils. Be-

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### MINIATURE 150v. VOLTAGE REGULATOR

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Type 6627/OB2WA Voltage Regulator is a miniature two electrode, inert-gas filled, cold cathode tube that maintains practically constant voltage within its ratings, even at continuous 150°C bulb temperature. Voltage drift is negligible throughout its life and dark breakdown voltage characteristics excellent.



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tween the signal separator 18 and the oscillator is an automatic frequency control circuit including the control tube 23. The received line synchronization signal is applied to the control grid of the tube 23 and the output of the oscillator amplifier 52 is fed back through a connection 65, condenser 66 and resistor 67 to the control grid of the control tube. The received synch pulse and the feed back pulse are of the same width but of opposite polarity. Normally the control tube 23 is non-conducting and, therefore, any noise between the synch signals does not pass through to the oscillator.

When the local oscillator is in synchronization with the synch signal, the synch signal and the feed back signal are in phase and the two signals cancel each other, so the tube 23 remains non-conducting. If, however, the feed back signal and the synchronization signal are out-of-phase, then a signal is generated, including a negative pulse produced by the negative synch signal having a width corresponding with the extent of out-of-phase and a positive pulse having a width corresponding with the out-of-phase relation. These two pulses are spaced by the feed back pulse from the amplifier cancelling out the negative synch pulse in the interval when the two signals

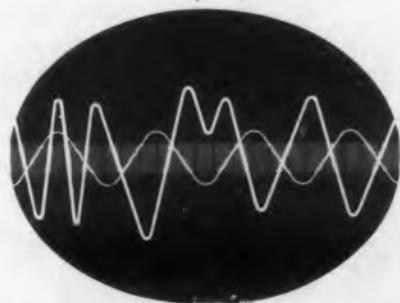
overlap. The control tube 23 is biased so that the positive pulse causes the control tube 23 to conduct. The width of the positive pulse is therefore determined by the extent of out-of-phase between the synch signal and the feed back signal. This width modulated signal is integrated by the condenser 37 and resistor 36 and applied to the control grid 38 of the oscillator. The frequency of the oscillator is determined by the amplitude of the pulse applied to its control grid so that the oscillator is brought into synchronism with the synchronizing signal.

#### Transistor

Patent No. 2,735,049. Lee de Forest, Los Angeles, Calif.

The patentee has discovered that a junction type transistor provided with a layer of electron multiplier material at the junction surface or surfaces secures an increased output from the transistor. Suitable electron multiplier materials are beryllium oxide and silver magnesium alloy. A further increase in output is secured when an electron multiplier material is provided at both junctions of a two junction type of transistor.

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# THE EASIEST WAY TO STABILIZE A CIRCUIT IS WITH A VICTOREEN CORONA TYPE VOLTAGE REGULATOR

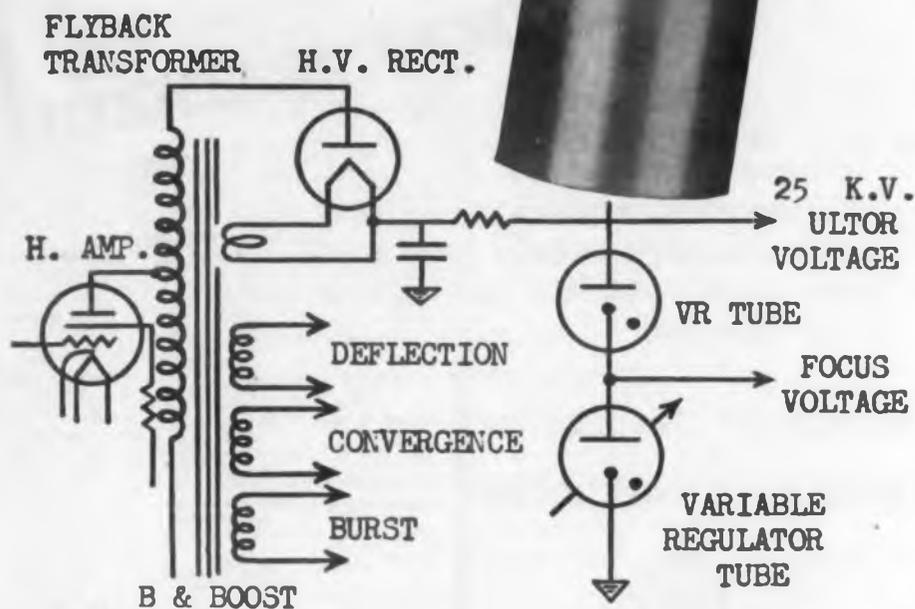
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These Victoreen corona type regulators are also used as reference tubes, trigger tubes, voltage limiters, oscillators and coupling elements.

Victoreen corona type regulator tubes are available in a complete range of ratings from 400 volts to 27,000 volts nominal; 100ua to several ma maximum current, depending on the application.

To broaden the understanding of corona type voltage regulators, Don Ward has prepared a discussion, "Some Design Considerations Applicable to Regulation By Corona Type Voltage Regulators" which will be mailed upon request.



**The Victoreen Instrument Co.**

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## Patent Briefs

### Color Television Tube Target Structure

Patent No. 2,745,035. Ernest O. Lawrence. (Assigned to Chromatic Television Lab., Inc., New York)

This patent is similar to 2,745,033, described above, except that the electron beam can be deflected in two dimensions. An electrode structure mounted adjacent and essentially parallel to the screen can be excited by a signal source and cause the beam to fall on the appropriate phosphor and produce the desired color.

### Solid State Amplifier

Patent No. 2,743,322. John R. Pierce, Harry Suhl. (Assigned to Bell Telephone Laboratories, Inc., New York)

An element of material exhibiting a large Hall effect is biased with a dc electric field and inserted in a wave guide. The electromagnetic field associated with the signal travelling down the wave guide interacts with the applied dc field and produces a Hall effect field. This Hall effect field in turn adds to the electric field of the signal and thereby produces amplification.

### Monatomic Semiconductor Devices

Patent No. 2,743,201. Ralph P. Johnson, Playa Del Rey, Robert G. Shulman, and Delbert M. Van Winkle. (Assigned to Hughes Aircraft Company)

A method of producing PN junction semiconductor devices. A first semiconductor specimen with a relatively rough surface is placed in contact with a second semiconductor specimen with a relatively smooth surface. The specimens are then forced together under pressure and heated until the first and second specimens fuse with each other in the vicinity of the junction.

### Electronic Time Constant System

Patent No. 2,743,358. Neil E. Handel. (Assigned to the Foxboro Company, Foxboro, Mass.)

An electronic integrating circuit which utilizes a capacitor connected between the grid and the plate of a vacuum tube. The Miller effect increases the effective capacitance as seen by the input circuit and thus produces a much longer time constant than would be possible with the capacitor alone.

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### Moisture Indicating Apparatus

Patent No. 2,742,780. Richard S. Feigal and Jerry Hagen. (Assigned to the Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.)

Moisture indicating apparatus utilizing a resistor whose resistance depends upon the moisture content. The resistor is driven with a sinusoidal current source so that the voltage appearing across the terminals depends upon the moisture content. Each moisture sensing element is connected to the input of a cathode follower and the output is connected to a meter at some remote location. The filaments of the cathode followers are normally cold except when a measurement is being made and thus the heat of the tube does not affect the moisture in the sensing element.

### Apparatus For Producing One Groove Binaural Records

Patent No. 2,743,110. Alan Freiberg, New York.

Apparatus for recording sound in a single groove in binaural records. One of the sound tracks is recorded with hill and valley cutting movement of the stylus while the second channel is recorded in lateral movement of the stylus.

### Magnetic Field Measuring Device

Patent No. 2,743,416. Joseph M. Kelly, Jr. (Assigned to the United States of America)

An apparatus for measuring the intensity of an unknown static magnetic field. The system utilizes two coaxial solenoids with a regulated dc applied to the outer solenoid and an ac signal applied to the inner solenoid. A sensing coil, wound on a thin molybdenum-Permalloy core sealed within a quartz tube, is placed in the center of the solenoids. When the known field produced by the outer coil just balances the unknown field, a voltage is induced in the sensing coil and the unknown field may be calculated.

### Waveguide Delay Line

Patent No. 2,744,242. Seymour B. Cohn. (Assigned to Sperry Rand Corp.)

An ultra high frequency delay line for operation at high power. The delay line utilizes a rectangular wave guide with regularly spaced baffles that extend into the wave guide perpendicular to the sides of the guide. Each baffle consists of a thin plate attached to a circular rod; the rod serves to increase the loading capacitance and inductance and reduces the breakdown voltage at the free edges of the baffle.

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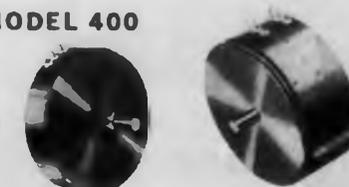
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## Books

**Computers—Their Operation and Applications**  
*Edmund Callis Berkeley and Lawrence Wainwright, Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y. 366 pages. Price: \$8.00.*

This book discusses newest developments in the techniques and equipment of automatic computers. Basic elements of digital, analog, and miniature computers are explained together with computer reliability, advantages, limitations, and maintenance. Other features include checklists of computer characteristics, listings of books, periodicals, etc., illustrations, and a glossary of terms and expressions.

**Proceedings—World Symposium on Applied Solar Energy**  
*Stanford Research Institute, Menlo Park, Calif. 304 pages. Price: \$5.00*

From October 31 through November 5, 1955, in Tucson, Arizona, two consecutive major meetings were held on applied solar energy. At this meeting 96 papers were presented, in parallel sessions, on the technical and scientific aspects of solar energy. This was followed by the World Symposium on Applied Solar Energy in Phoenix, Arizona.

These meetings marked one of the first objectives of the Association for Applied Solar Energy, and to hasten the utilization of the sun's energy.

The meetings brought together 900 scientists who have engaged in solar-energy research, and also many representatives of industry, finance, government, and education whose interest, enthusiasm, and abilities are needed to bring solar-energy utilization into being.

The Solar Engineering Exhibit, held in conjunction with the Symposium, was attended by nearly 30,000 persons. On display, and photographed in this book are examples of solar devices which included many working models.

Papers presented at the Symposium are contained in this volume.

**Reactor Shielding Design Manual**  
*Theodore Rockwell, Ill. McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N.Y. 488 pages, price \$6.00.*

The information is presented in this book in the order a designer would have to accumulate it in developing a shield design. The book deals with such subjects as basic processes, determining allowable radiation levels, shielding the reactor core and the cooling system, shield engineering, the effect of irregularities in the shield, and the effect of geometry on radiation source. The influence of plant layout, structure, and maintenance upon design is taken into account.

The methods discussed form a basic approach rather than a mock-up approach and thus permit design of shields without expensive and time-consuming use of the reactor facilities in which full-scale shielding mock-ups can be made. This should lessen the time required for the design of power reactor shields.

The contributions of a number of workers are represented in the book, as the shielding procedures described were developed along somewhat different paths and at different sites. The book pulls together scattered theory and joins it with some previously scattered practical material and naval experience so as to make a composite whole.

**Elementary Nuclear Theory—Second Edition**  
*Hans A. Bethe and Philip Morrison; John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. 274 pages. Price: \$6.25.*

The second edition of nuclear theory has been expanded and all topics brought up to date. Coverage reflects the extension of nuclear experiments to the energy range of hundreds of Mev.

Experimental ideas are discussed. A list of nuclear species is also included along with exchange and interaction currents, high-energy nucleon interactions, present status of theory of beta-decay, etc.

**History of American Technology**  
*John W. Oliver, The Ronald Press Co., 15 E. 26th St., New York 10, N.Y. 676 pages. Price: \$6.50.*

This volume surveys the part played by science and technology in the development from colonial times to our present position of world leadership. Its primary aim is to give science and engineering students a

more comprehensive understanding of the importance of their work, and that of their forerunners, to American civilization as a whole.

The book is organized topically within a chronological framework. Taking a cross-section of various areas of technology in a given period, such as manufacturing, communication, transportation, etc., it shows concretely the status of technology during that period in relation to periods before and after it.

**Common Sense in Research & Development Management**  
*George W. Howard, Vantage Press, Inc., 120 W. 31st St., New York 1, N.Y., 104 pages. Price: \$2.75.*

This volume presents an impartial, comprehensive report on methods used in industrial, university, and governmental research and development establishments.

This book discusses items such as organization for effective control, selection of personnel, professional development of the worker, etc. Included are illustrative charts.

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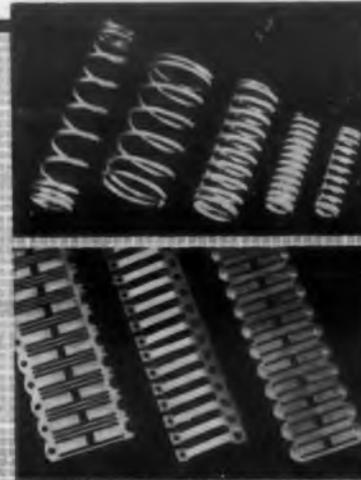
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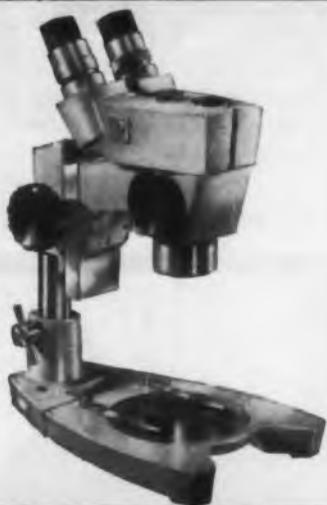
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## Russian Translations

# What The Russians are Writing

J. George Adashko

### Radiotekhnika, No 2, 1956

Connection between the (van der Pol) Approximate Equations and Power Balance. S. I. Evtianov (11 pp, 4 figs.)

The method of approximate equations is used widely for the analysis of stationary and transient processes in self-excited harmonic oscillators. Approximate equations introduced to radio-engineering practice by van der Pol and also in a less developed form by Moller have been widely employed by Russian workers in the study of non linear circuits. Russians particularly active are Mandel'shtam and Papaleksi, Krylov and Bogoliubov (whose book is available in an English translation), Kobzarev, Teodorchik, and Evtianov. This article uses the behavior of a self-excited oscillator to derive the simplified equations from the balance of active and reactive power in the circuit. The advantage of the method is that they can be obtained from simple physical concepts and do not require writing down the complete differential equations of the system.

Non-Linear Distortion in Multi-Channel Communication System Using Frequency Modulation. V. A. Smirnov (15 pp 4 figs.)

Employs standard spectral-analysis methods to discuss the non-linear distortion produced in microwave relay systems by multi-path propagation and to study non-linear distortion produced in waveguides that are not fully matched to the antenna or to the receiver. Refers to articles in the *Bell System Technical Journal* by Bennet-Curtis-Rice and Holbrook-Dixon.

On the Theory of the Exponential Line, B. P. Afanas'ev, (14 pp, 5 figs.)

The exponential line has been used by many writers as a particular example of a long line with variable distributed parameters. The exponential line also gives best results when used for impedance matching. This article develops equations for the

amplitudes of the currents and voltages in the lossless exponential line that are quite analogous with the corresponding equations for a uniform line. This leads to an expression for the wave impedance of an exponential line and again makes the matching conditions analogous for both types of lines. The wave impedance in this case is a complex quantity, and this in turn leads to the concept of a reactive travelling wave.

Equations are also derived for the travelling-wave coefficient, for the reflection coefficient, for the input impedance, and for the distribution of amplitudes in certain specific cases of line loading.

Interaction between Signal and Noise in a Detector with Inertia, L. S. Gutkin (11 pp, 6 figs.)

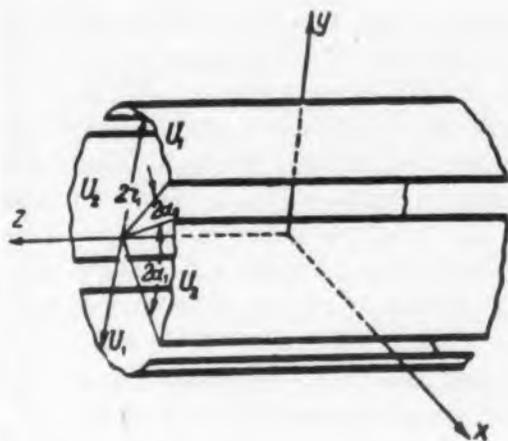
An ordinary diode detector may show no inertia whatever for a useful signal yet may exhibit considerable inertia for noise, particularly if the noise spectrum is quite wide. The article gives a mathematical analysis of the simultaneous detection of signal and noise voltage by a linear inertia detector. The input impedance of the detector is determined and the results of detection of unmodulated and amplitude-modulated signals are given. The frequency spectrum and the effective value of the noise voltage at the detector output are calculated. The equations derived are compared with the corresponding relationships for the inertialess detector.

Evaluation of Selective Properties of Resonant Systems. I. M. Simontov and Ia. I. Fet (6 pp, 4 figs, 2 tables)

The selective properties of resonant systems are evaluated by comparing interference-spectrum oscillations with the relative power of the useful spectrum oscillations. A selectivity criterion is established and it is shown that the use of other criteria leads to erroneous deductions.

Theory of the Deflectron, A. M. Strashkevich (6 pp, 1 fig.)

The Deflectron was described in this country by K. Schlesinger (*Electronics*, July 1952). Judging from the number of references cited, Strashkevich has published at least seven other papers on the subject, covering the focusing and deflecting properties of the device and its electron-optical behavior. This article gives a mathematical discussion of the potential distribution in a system shown in the figure.



Calculation of the Amplification Factor and of the Principal Characteristics of a Transistor Amplifier Stage. G. S. Tsykin (4 pp, 4 figs.)

It is shown that the equivalent circuit of a transistor can be reduced to the form usually used for the electron tube. Expressions are given for the parameters of the equivalent circuit for various transistor connections. Sample calculations are given for standard transistors, and a method is indicated for determining the frequency and phase characteristics of single-stage and multiple-stage transistor amplifiers. To be abstracted in *ELECTRONIC DESIGN*.

Concerning the Problem of the Relationship between the Observability of an Object and the number of "Illuminating" Pulses. G. I. Bystrov (3 pp)

A probability study giving the detection probability from the signal-to-noise ratio and the number of pulses transmitted to the object.

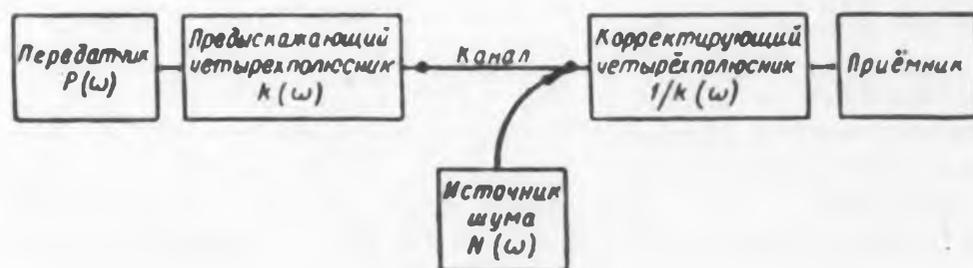
Geometric Derivation of Equation for Transmitting Ability of a Noisy Communication Channel employing a Special Receiver. A. M. Vasil'ev (3 pp)

The "special" receiver referred to separates from among all the received signals the particular one that differs from all the received signals by the amount of noise power. Probability theory is used in this article too.

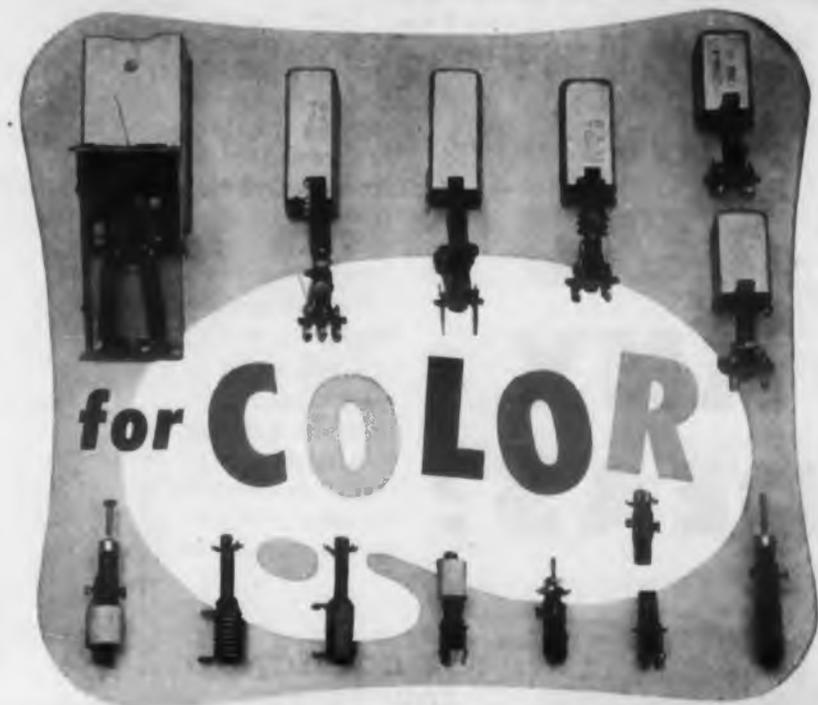
Design of Linear "Pre-distorting" and Compensating Devices, V. M. Shtein (4 pp, 2 figs.)

The signal-to-noise ratio in a transmission system is sometimes improved by connecting a linear pre-distorting four-terminal network at the input of the channel, and connecting a linear four-terminal compensating network at the output of the channel. Figure shows such a system. The signal from a transmitter, with a power spectrum  $P(\omega)$

passes through the pre-distorting network, which has a transfer coefficient  $k(\omega)$ , before entering the line. The correcting network has a transfer coefficient of  $1/k(\omega)$ . The noise source with spectrum  $N(\omega)$  is assumed connected to the line output. The article gives a method for calculating the two networks so as to produce either a maximum signal-to-noise ratio for a given value of signal power, or else determine the minimum signal power required to maintain a given signal-to-noise ratio.



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TRANSFORMERS

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## Govt Abstract

# Field Testing of Electron Tubes

**F**IELD testing at forward echelons is concerned with preventative maintenance and equipment repair. As a part of these maintenance and repair measures, electron tube testing has as its principal aim the restoration of equipment to optimum operating condition.

However, for most effective evaluation, the parameters of an electron tube must be measured in conjunction with the specific circuitry connected with the application, and not, as in the conventional tester, under a set of fixed conditions in no way typical of the particular application.

Although there are many instances in which the correlation between a tube parameter and a circuit application has been established, those cases in which correlation does not exist are far more numerous, and are steadily increasing.

Fully adequate field testing of electron tubes for the maintenance and repair of equipment is now impossible, hence the inherent limitations of the available conventional testers are presented, together with recommendations that field users of tube testers be made aware of the significance of the data obtained.

From the viewpoint of testing, an electron tube may be considered either an entity in itself or as one element of a circuit.

In the production, storage, and issue of tubes, the specific circuitry in a given application is generally not considered; that is to say, the tube is considered as an entity in itself. The quality of any tube type for these purposes is defined by a specification in which certain control parameters are identified.

These control parameters concern not only such

electrical characteristics as emission, transconductance, interelectrode capacitance, and the like; but also such mechanical aspects as envelope size, grid-wire sag, tension and spacing, electrode dimensions and spacing, and so forth.

The measurement of electrical and mechanical characteristics provides data which, when compared to the specification requirement, allows a judgment to be reached in determining the acceptability of the tube. Such a measurement of quality yields a very precise result, eliminating any ambiguity that might otherwise arise.

### Circuit Element

When the tube is considered as a circuit element (part of a multivibrator circuit, oscillator section, and so forth) the problem of adequate measurements is not so simple. Judgments of tube acceptability must be based on data related to the circuit involved. These data are obviously obtained by measurement of tube parameters. This indicates that a selection must be made of that tube parameter (or parameters) significantly related to the circuit application.

### Main Types of Tubes

At present there exists in excess of 1000 types of receiving tubes alone, each differing in some respect. This number includes over 800 multielement tube types—triode, tetrode, pentode, and so forth—used in endless circuit variations. These statistics serve to point out the almost impossible task imposed on

device designed to measure the quality of a tube for a particular application.

In the light of the foregoing, it would seem that the problem of testing a tube to determine its "goodness" for a given usage cannot be answered except by determining solutions to the following questions:

What tube parameter must be measured?

How can this parameter be measured?

Can one testing equipment be employed to measure all parameters, independently of others, for all types of, say, receiving tubes?

The mathematical and graphical analysis of vacuum tube circuits and vacuum tubes require the use of certain tube factors whose numerical values are dependent upon the construction of the tube and upon the electrode voltages and currents. These factors serve as indices of the ability of given tubes to perform specific functions. Certain of these factors, the mutual conductance of the control grid-plate (mutual conductance), predominate in importance in the analyses of tubes and circuits.

Commercial companies, in their developments to provide servicing gears, provide equipment designed to measure emission and mutual conductance. The quality of a tube as indicated by a measurement of transconductance is sufficient to establish whether the tube performance would be satisfactory when the application is one in, say, audio circuitry.

However, important as the transconductance factor may be, it is a lesser factor when the tube is being evaluated for application in a high frequency oscillator. The critical factor in this case is interelectrode capacity, normally controlled by a manufacturing specification.

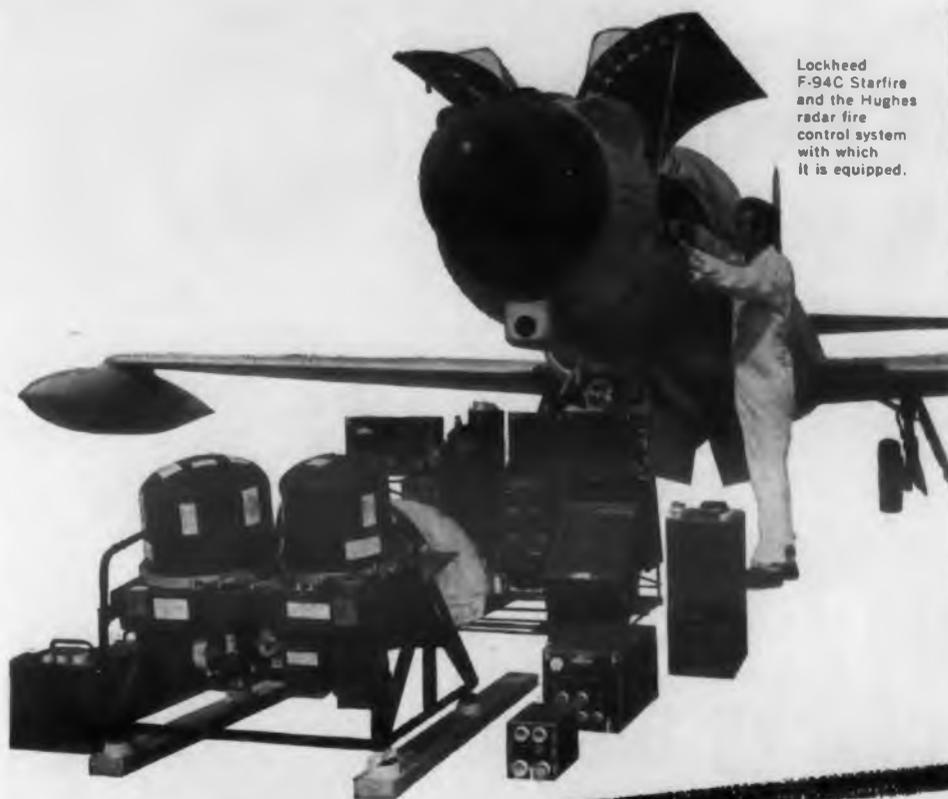
Again, transconductance is of lesser influence in determining the acceptability of a tube for use in a multivibrator circuit of a computer, where cathode interface resistance is critical.

### Limited Value of Tube Testers

Inasmuch as present-day operating conditions and advanced circuitry require close control over critical tube parameters which do not lend themselves to field measurement, the military tube tester is of limited value as a maintenance device.

Furthermore, many of the current tube testers are inherently incapable of accomplishing the function for which they were designed with any but the most approximate accuracy.

Specifically, it can be concluded that the current military tube testers can be employed as useful maintenance tools only when (1) tube acceptability is to be determined for application in which the parameters of transconductance and emission are significant; and when (2) circuit conditions under which the tube will operate involve voltages not appreciably different from those impressed by the tester. *Abstracted from Field Testing of Electron Tubes, Bureau of Ships Journal, June 1950, page 29.*



Lockheed F-94C Starfire and the Hughes radar fire control system with which it is equipped.

*Hughes has been the leader from the beginning in applying electronic computers to airborne fire control equipment. Today every U.S. Air Force and Canadian continental defense interceptor uses Hughes-developed and Hughes-manufactured systems.*

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As the intercept problem becomes more and more automatic, additional equipment such as new-type computers, control surface tie-in (CSTI), autopilots, and other units must be integrated into the system. Faster speed and heavier engines dictate more streamlining—and hence less space for electronic gear. The result is even more miniaturization and compact packaging, evolved from special techniques.

This all means that now the product design engineer is more important than ever before. In the Product Design Laboratory he is a vital part of the formal link between the Research and Development activity and the optimum configuration and installation arrangements for the systems "black boxes."

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## "On-The-Nose"

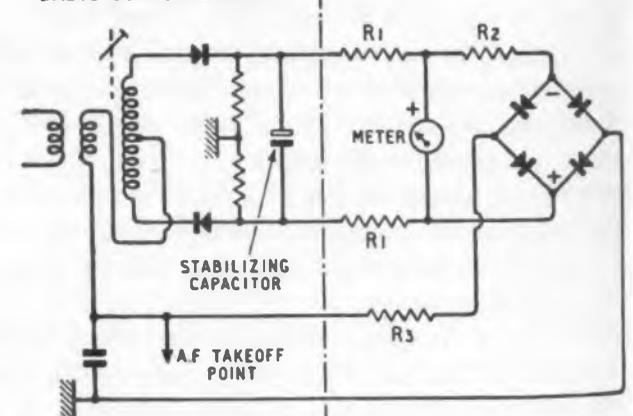
**D**ESCRIBED here is a means for accurately tuning in fm signals where ratio detectors are employed.

For undistorted reproduction of fm signals the if characteristics should have a flat top a few hundred kilocycles wide. A voltmeter on the avc line, if any, or across the stabilizing capacitor of the radio-detector circuits, will indicate the same maximum reading anywhere on the flat top, giving no guidance to the center point. Also, it will lead to completely unsymmetrical tuning if the if is lopsided or dog-eared. This method is commonly used, however, as it permits the use of a "magic eye" indicator which requires an input with one side grounded.

Another type of meter circuit observes the dc voltage at the af take-off point of the ratio-detector. This voltage is positive on one side of the correct tuning point and negative on the other, so that a center-zero meter can be used to find the null point. The disadvantage, apart from the necessity for a center-zero meter, is that the same (zero) reading is obtained on tune and well away from tune, making the reading difficult to interpret.

The circuit in the diagram combines the above two methods to give a meter reading which is a maximum on the exact center of tuning and falls away to zero on each side. Assume  $R_2$  disconnected: if a signal is present the meter will read with the

BASIC OUTPUT CIRCUIT



Circuit of the tuning indicator. Suggested values for the resistors (all  $\frac{1}{4}$ -W) are:-

Meter Sensitivity	$R_1$	$R_2$	$R_3$
100 $\mu$ A	220k	10k	220k
250 $\mu$ A	100k	10k	47k
500 $\mu$ A	47k	22k	22k

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The airfoil blades and stationary vanes of JOY fans are made with power-saving, efficient airfoil cross-section. AXIVANE design provides equal pressure and velocity distribution across the fan outlet . . . eliminates turbulence . . . and produces the greatest cooling effect with the least expenditure of power.

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Joy offers a large selection of fans in the standard line . . . as well as custom-designed types that are available to your specifications. The Joy line includes fans for all purposes ranging from 1/500 HP to 3000 HP. You'll find a fan to suit your needs in the JOY line. Let us work with you. Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa. In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.

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## FM Tuning

normal if flat-topped response. If the remainder of the circuit is now connected, any unbalance voltage at the af take-off point will pass an opposing current through the meter, reducing the reading. The current rectifier insures that the current will oppose that through  $R_1$  whatever the polarity of the unbalance voltage. If the unbalance is zero, the opposing current is zero and the meter will read a maximum, but the slightest mistune will reduce the reading.

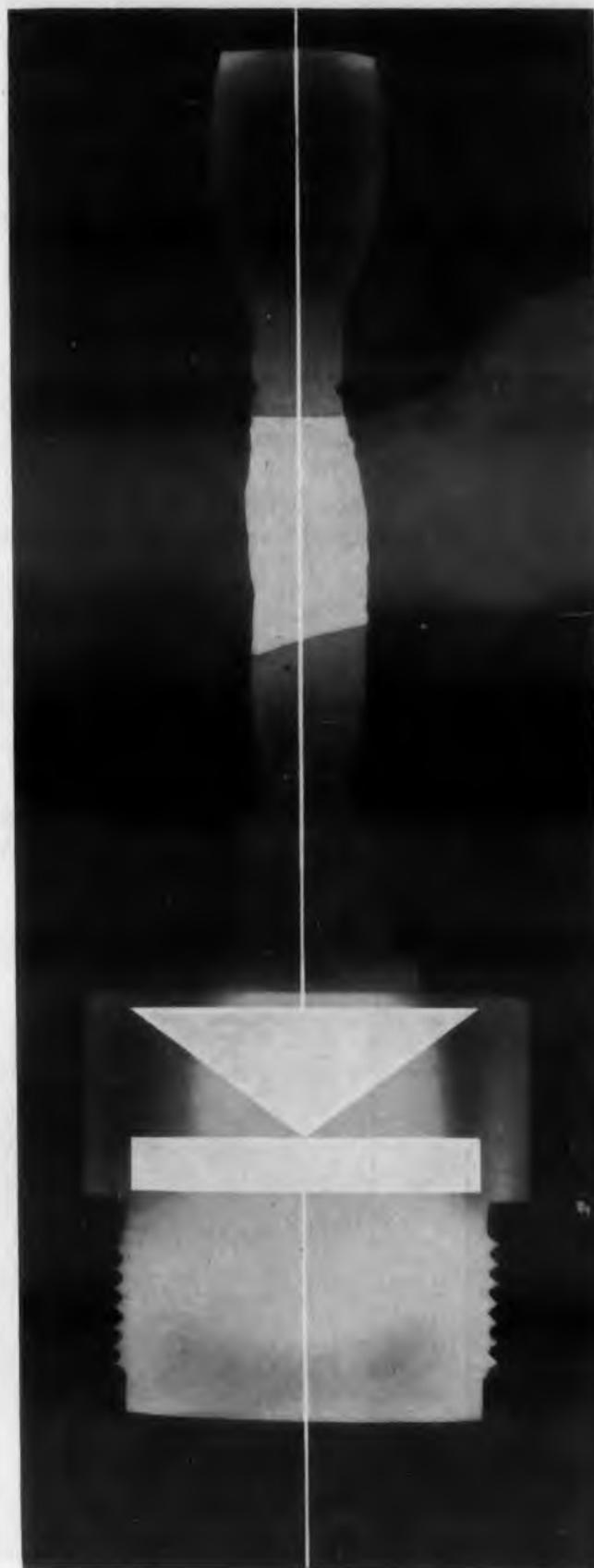
Suitable resistor values are suggested for several meter sensitivities. The rectifier is a 1-ma meter rectifier, commonly found in ac voltmeters.

The purpose of  $R_2$  is to prevent the rectifier from shunting away from the meter part of the standing current through resistors  $R_1$  and so reducing the maximum possible reading. The extent to which this occurs depends upon the resistance of the meter movement; and the value of  $R_2$  should be as low as possible. In some cases it can be zero, and a quick check (with  $R_3$  disconnected) will show what is the smallest value which can be used without reducing the reading by more than, say, 10 per cent.  $R_3$  should be as high as possible to avoid shunting the af output, but higher values will reduce the "sharpening" effect of the unbalance voltage. For this reason 500 microamperes is about the least sensitive meter that can be used.

To decide on resistor values for a particular meter and tuner, first connect only the meter and resistors  $R_1$  to the values in the table. Tune in a strong signal and vary the values of  $R_1$  (keeping them equal) to give about 60 per cent full scale or whatever is a convenient maximum reading. Now add the rectifier across the meter (the "wrong" way around) with  $R_2$  zero. If necessary, insert some resistance at  $R_2$  as described above, to avoid a large drop in reading. Finally, connect  $R_3$ , using for a start a value equal to  $R_1$ , and try the effect of detuning. If it is not sharp enough, reduce the value to  $R_3$ .

It may be noticed that the meter reading is a bit unsteady-looking if the tuning is rapidly changed. This is due to the stabilizing capacitor preventing rapid changes of output voltage, although the unbalance voltage changes immediately. In practice, the tuning is moved slowly when approaching proper tune, and the effect is not noticeable.

Abstracted from an article "FM Tuning Meter" by Robert S. Ferguson, *Wireless World*, July 1956.



## NEW WESTINGHOUSE HIGH-POWER SILICON RECTIFIER

*475 amperes d-c. . . .  
300 volts PIV*

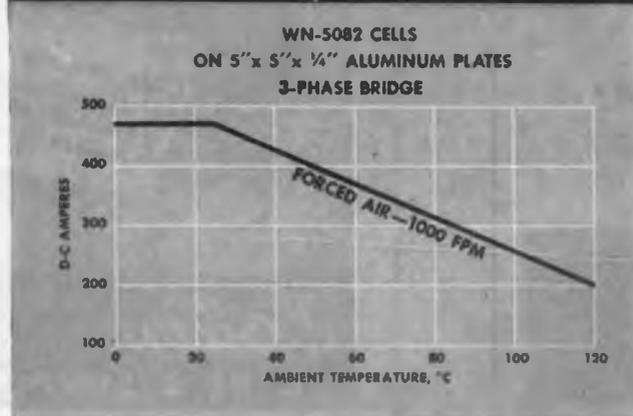
Highest power silicon rectifying cell commercially available . . . that's the Westinghouse WN-5082!

Ambient temperatures present no heat problems for these silicon cells—units operate in temperatures up to 175° C. Curve below shows forced air-cooled, three-phase bridge ratings.

This diode is ideally suited for railway, elevator, arc welder, battery charger and other industrial high-power applications.

Production quantities are available immediately. For more information on the WN-5082, or any other silicon rectifier requirements, regardless of voltage and current, call your nearest Westinghouse apparatus sales office. Or write Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-09004

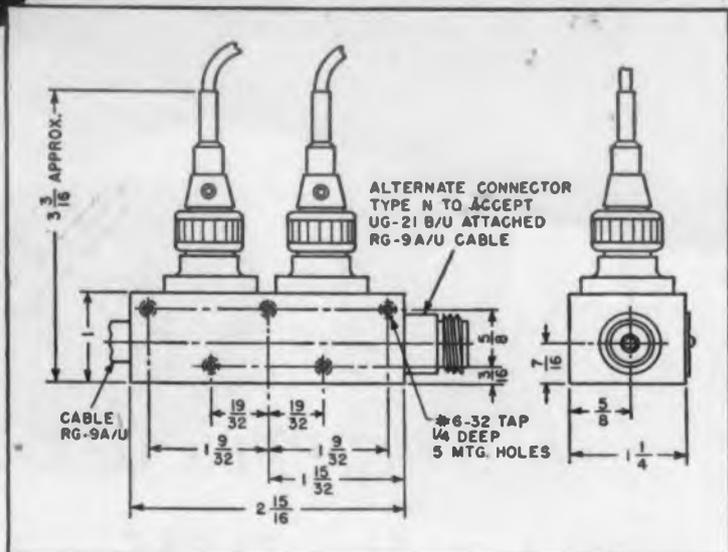


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## Abstracts

# Determining Combined Power of Two Signals

**T**HIS chart simplifies the power addition of two signals whose levels are expressed in db. It is especially useful for determining the resulting power when two sources of cross talk, speech or noise are combined.

To use the chart, locate the db difference between the two known signals on the *x* axis. Number of db to be added to the larger quantity to get the combined signal level is found on the *y* axis.

### Example

A microwave system producing 26 dba of noise and a cable carrier producing 29 dba of noise are to be connected in parallel. Difference is 3 dba. From the chart, 1.76 dba must be added to the larger quantity. Total noise will be  $29 + 1.76$  or 30.76 dba.

*Material for this article has been furnished through the kind cooperation of Lenkurt Electric Co., San Carlos, Calif.*

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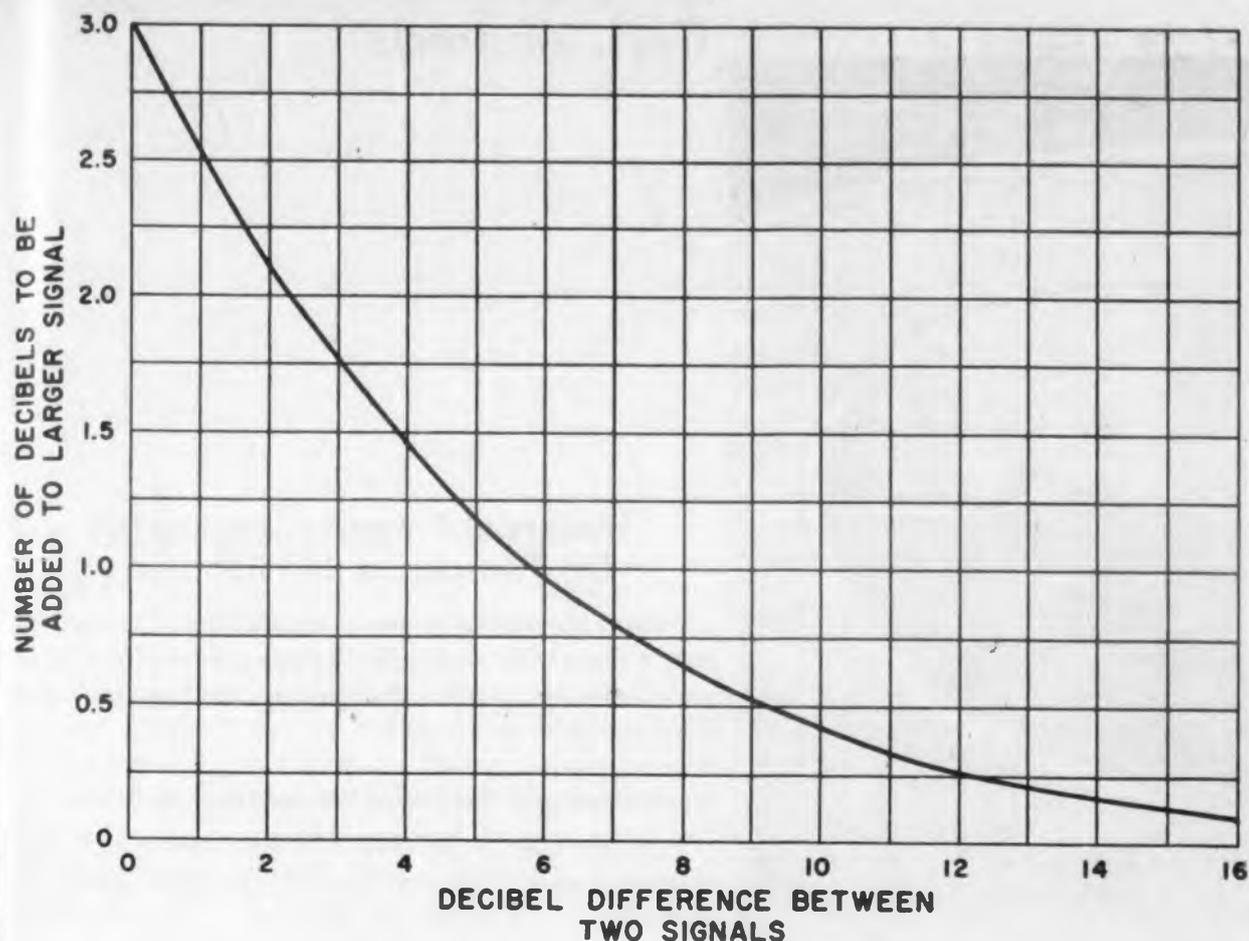
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**HYCON EASTERN**



Shown 1/2 size  
Crystal Filter Model 13MA  
patent pending

**CRYSTAL FILTERS**

Hycon Eastern is now producing standard Crystal Filters with extremely high selectivity at frequencies which eliminate the need for multiple conversions. Among these are Model 13MA and Model 13MB for use in VHF FM receivers. Model 13MB may be used in AM receivers as well as in the proposed split channel FM systems. Their low insertion loss, linear transfer characteristics and non-microphonic qualities permit their location at any point of low signal level such as between the mixer and the i.f. amplifier. For FM applications Hycon Eastern has available standard Crystal Discriminators centered at 13Mc which may be used in conjunction with Model 13MA or Model 13MB.

SMALL SIZE — ONLY 3 1/2" X 1" X 1 1/2"

- FREQUENCY SHIFT LESS THAN  $\pm 0.005\%$  TOTAL FROM  $-55^{\circ}$  C. TO  $+85^{\circ}$  C.
- NON-MICROPHONIC
- UNAFFECTED BY IMPEDANCE VARIATIONS COMMONLY ENCOUNTERED IN TRANSISTOR CIRCUITS
- WORKS DIRECTLY TUBE-TO-TUBE OR TRANSISTOR-TO-TRANSISTOR WITH NO PADDING
- HERMETICALLY SEALED, NO ALIGNMENT OR READJUSTMENT NECESSARY

**ELECTRICAL SPECIFICATIONS — MODELS 13MA and 13MB**

Center Frequency: 13Mc  
 Bandwidth at 6 db Attenuation: 30 Kc (Model 13MA)  
 Bandwidth at 6 db Attenuation: 15 Kc (Model 13MB)  
 Shape Factor:  $\frac{60 \text{ db Bandwidth}}{6 \text{ db Bandwidth}} = \frac{1.8}{1}$   
 Power Insertion Loss: 6 db Maximum  
 Passband Response Variation:  $\pm 1$  db Maximum  
 Ultimate Attenuation: 80 db Minimum

Write for Crystal Filter Bulletin

**HYCON EASTERN, INC.**

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The height of imaginative resourcefulness and engineering skill are required to create the degree of precision—hitherto unattained—in the components essential to the guidance of advanced missile systems—the gyros, accelerometers, and computer elements. Miniaturization must be coupled with extraordinary ability to provide utmost accuracy under conditions of extreme velocities, temperatures, and accelerations.

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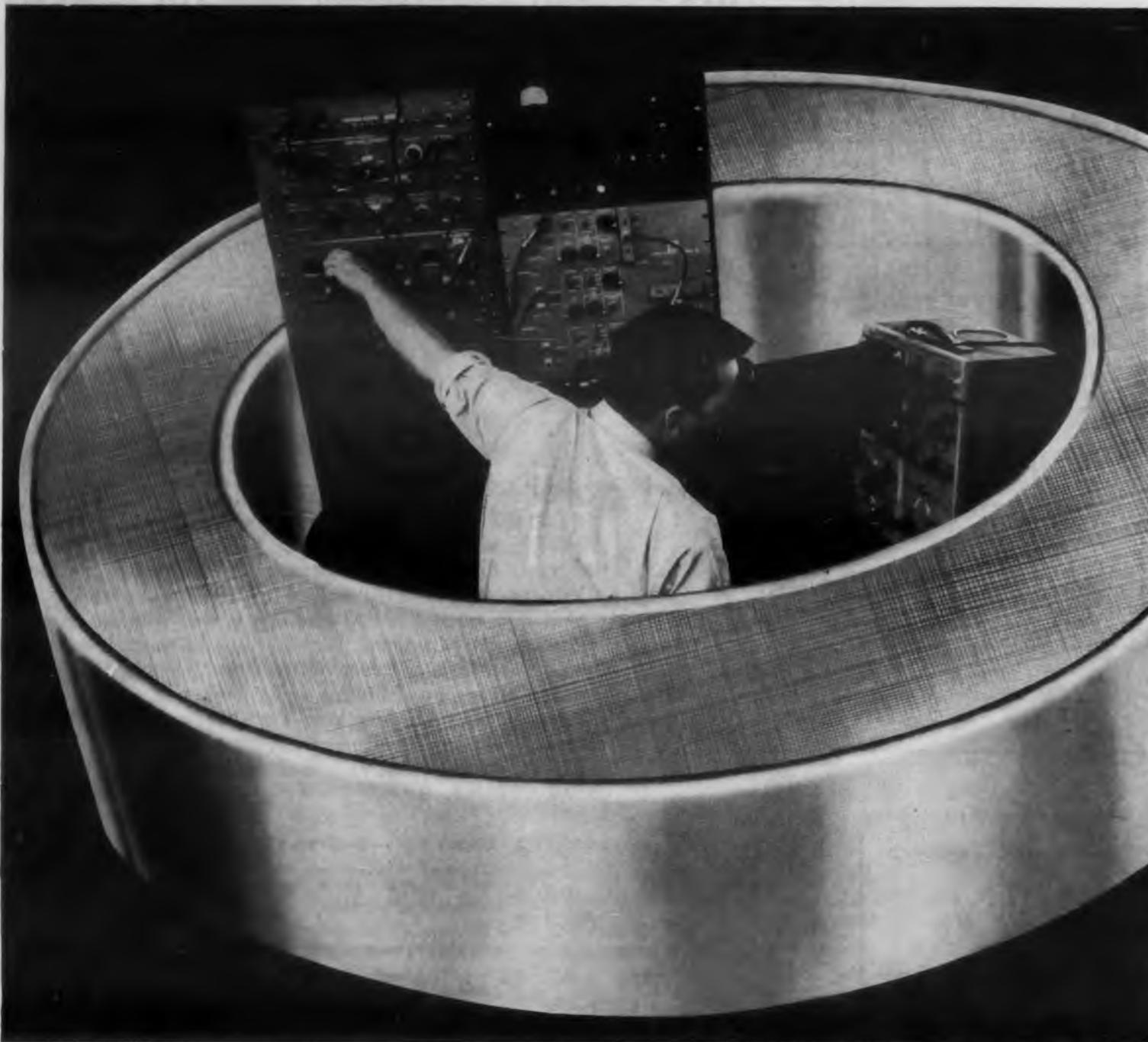
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## what makes tape wound cores reliable?

*Reliability demands physical protection.* Magnetic alloys which provide square hysteresis loop characteristics are strain sensitive. Distortion caused by coil winding will disturb precise magnetic characteristics, alter performance. So Magnetics, Inc. has devised a rigid, extra-strong aluminum core box to protect the magnetic core within from winding stresses, thus eliminating distortion.

*Reliability demands electrical stability through the years.* Suppose guided missiles failed to function in a future emergency because the magnetic properties of tape wound cores had changed. Cores must operate just as effectively years from now as they do today, whether or not they have been in use. Vibration, shock, and temperature changes can endanger such performance. That's why Magnetics, Inc. cushions tape windings with a special inert material in the extra-strong aluminum core box. And that's why it is especially important that our tape wound cores enclosed in aluminum boxes will withstand temperatures up to 450°F.

*Reliability demands exacting standards on the part of the manufacturer.* Judge a product by the company that makes it. Take a company that has pioneered a core box so advanced that it even permits vacuum impregnation. Take a company whose attention to design detail permits the offer of the *only* Performance-Guarantee in the industry. That's a real definition of reliability. Why not ask us how it will work for you? *Magnetics, Inc., Dept. E-32, Butler, Pennsylvania.*

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CABLE: MAGNETICS

## Govt. Abstracts

### Industrial Preparedness Studies On Transistors and Rectifiers

Two Industrial Preparedness Studies for the U.S. Army Signal Corps Supply Agency, one on transistors and the other on silicon power rectifiers, have just been released to industry.

#### Transistors and Transistor Manufacturing Equipment

Purpose was to develop a point-contact switching transistor and a general purpose junction transistor. Necessary manufacturing equipment and facilities were to be designed, built and operated on a pilot run. Volume 1 of this report reviews the engineering development work and summarizes the design features of these two transistors. Pilot production problems encountered were discussed, and complete manufacturing instructions (Standardizing Notices) for both types were included. Volume 2 contains descriptions and photographs of the mechanized equipment developed for point-contact production. *Final report. Radio Corp. of America for Signal Corps Supply Agency. May 1955. Two Vols. Vol. 1—PB 111822, 200 pp. \$5.00. Vol. 2—PB 111820, 42 pp. \$1.25.*

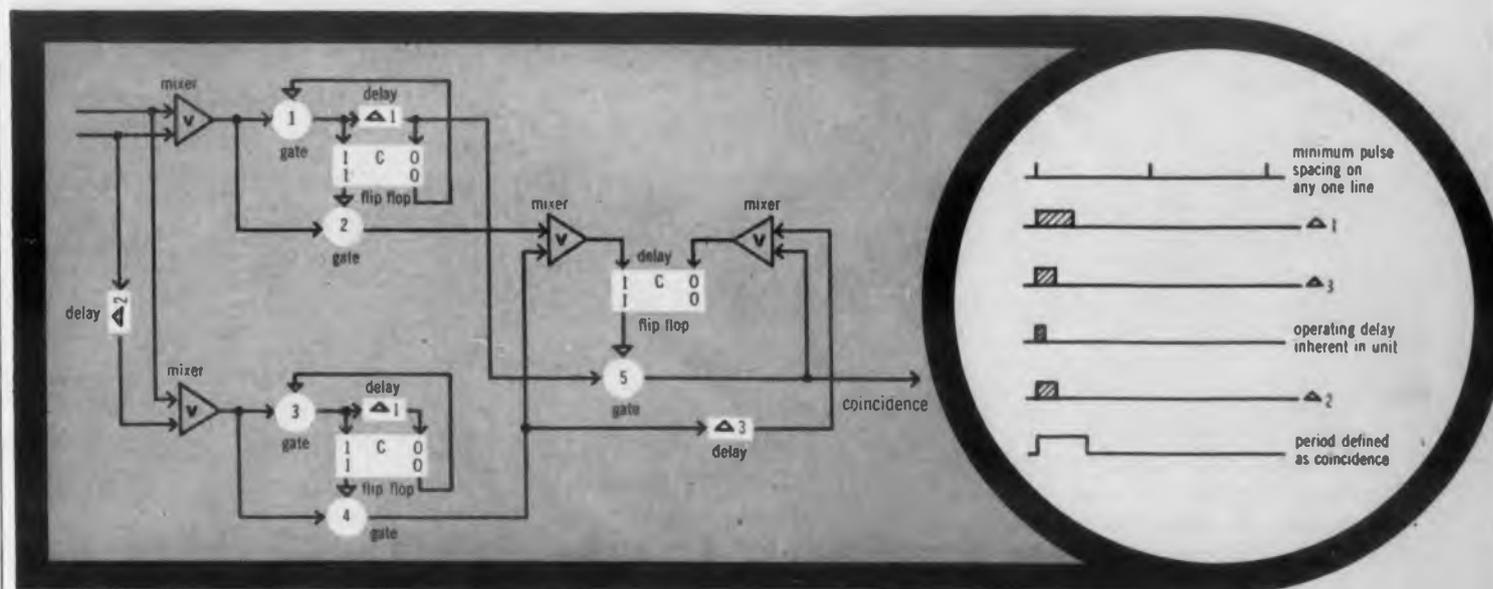
#### Silicon Power Rectifiers

Process improvements, including development of soldering the silicon junction wafer directly to the base and further development on welding the lead at the final sealing operation, have increased the yield and improved the mechanical and electrical characteristics of silicon power rectifiers manufactured according to procedures described in this report. The process used for assembling the rectifiers has proved to be entirely feasible, and the aim of developing it along lines suitable for mass production has been successfully met. A number of processing steps which, at present, are still hand-operated, can be readily converted to automatic techniques. The process is now already partly mechanized, and is rapidly being completely mechanized. This will allow considerable expansion of present production rate. *PB 11819 Industrial Preparedness Study: Silicon Power Rectifiers, Quarterly Progress Report. Transistron Electronic Corp. for Signal Corps Supply Agency. Jan. 1955 to Apr. 1, 1955, 33 pp. \$1.00.*

## solving logical problems with Burroughs pulse control systems

### detecting coincidence between two random trains of pulses

The diagram below shows a quick, easy logical method of detecting coincidence between random pulses on two different lines—pulses which might occur simultaneously, well within the switching time of even the fastest units. In this case, the systems approach proved to be more feasible than increasing the precision of the components.



### Analog-Computer Simulators

A basic reference book covering rudiments of operation and maintenance common to all analog-computer simulators has been prepared by the Navy and made available to industry. The text, a project of the Special Devices Center, Office of Naval Research, is intended to bridge the gap between the better-understood synthetic trainer, such as the basic Link flight simulator, and increasingly complex modern trainers. Part I of the 2-part book covers general principles of analog computers. Part II describes individual components used in servo-mechanism and computer systems, and procedures in general maintenance. Most examples refer to the Navy's Operational Flight Trainers, although principles demonstrated are said to be applicable to other simulators. Digital computers are covered briefly in the appendix with descriptions of arithmetic processes and a simplified outline of the binary system. *PB 121200 The Principles of Computer Simulation, Special Devices Center, Office of Naval Research, Sept. 1955, 158 pp. Price \$3.00.*

### Categorized Reports

Atomic Energy Commission research reports are now available in eight category "packages." This service has been established to meet the demand by scientific and industrial organizations for a bulk purchasing arrangement. Each package contains all AEC reports in its category available through OTS in full-size, printed copies, as of May 21, 1956. Subject categories and prices are shown below. The prices take into account reduced handling cost made possible by bulk packaging and sale of documents.

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Engineering (105 reports) .....	34.00
Geology & Minerology (144 reports) .....	42.00
Instruments (292 reports) .....	62.00
Metallurgy & Ceramics (380 reports) .....	92.00
Physics (1190 reports) .....	280.00
Miscellaneous (55 reports) .....	23.00

The packaged reports may be purchased from OTS, U.S. Department of Commerce, Washington 25, D.C.

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# Microwave Frequency Meters by FREQUENCY STANDARDS

In offering these frequency meters we have endeavored to bring to the electronics industry instruments for frequency measurement which are fairly priced yet without sacrificing a high degree of accuracy resulting from precision manufacture. The frequency determining element of these instruments is a cylindrical resonator with a tuneable choke plunger that provides a smooth and accurate interpolation of frequency. Four models are offered, each model covering a wide frequency range and employing standard waveguide and flanges. Three types, described below, are offered in each frequency range. All models have been designed to use the standard FS Model M-1000 Micrometer Head which has been widely accepted by the electronics industry. Construction is of Invar and accuracy is .01% under laboratory conditions.

DESCRIPTIVE LITERATURE AVAILABLE ON REQUEST

TYPE	FREQUENCY RANGE	WAVEGUIDE
Models 8211- 3	8200 to 11500 MC	RG-52/U
Models 7010- 3	7000 to 10000 MC	RG-51/U
Models 5882-1, 2, 3	5800 to 8200 MC	RG-50/U
Models 4458-1, 2, 3	4400 to 5800 MC	RG-49/U

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## Three Types Available

**WAVEGUIDE ABSORPTION TYPE I** cavity is mounted on the broad face of waveguide. The transmission indication is secured by a crystal loop monitor located opposite the iris input coupling hole. (Type illustrated)

**WAVEGUIDE FEED TYPE II** cavity is mounted as the termination of a short section of waveguide. The cavity body and output coupling loop are the same as Type I.

**WAVEGUIDE TRANSMISSION TYPE III** cavity is the same as Types I and II but waveguide is used for input and output coupling.

## Abstract

## Standardizing

**L**ACK of completeness, difficulty of control, confusion, and discouragement of higher quality are the four major pitfalls which may occur when the electronic designer-buyer prepares procurement specifications for the material which he buys, according to the Engineering Department of Radio-Electronics-Television Manufacturers Association. These pitfalls arise from the inability of the customer to prepare a complete spec for lack of detailed knowledge of the product, or the parameters which he uses to describe the product may not be feasible of verification or control. In addition, several consumers may be buying the same product, yet each describes it in his own terms. This may create extensive problems in production, stock control, and the provisioning of spare parts. Use of a consumer's spec often encourages the procurement of the cheapest product which will apparently meet the stated requirements. This condition arises from the buyer placing the responsibility on his incoming inspection to meet the effective quality.

One of RETMA's solutions to this expensive and time consuming method of procurement is to have the buyer arrange to make maximum use of the seller's test facilities by means of a mutually agreed upon, certified, test program. The product must conform en masse to the mutually agreed upon requirements. Lots or shipments which contain a significant degree of non-conformity should be considered unacceptable as a whole. In order to make such a plan workable and economical, some allowance should be made for non-conformity by means of an Acceptable Quality Level (AQL).

The AQL is defined as the maximum percent defective or the maximum number of defects per unit which can be considered satisfactory as a process average; i.e., it is the poorest quality which a supplier can be permitted continually to present for acceptance.

RETMA further recommends that, since it is far too expensive and time consuming to calculate the optimum AQL for each individual procurement and since industry standards are being established by

## Quality Acceptance

negotiations between groups of producers and consumers, these industry standards be used as much as possible.

The AQL should form a part of the purchase spec either directly or by reference to a recognized standard. It should appear either on the purchase order, or piece part print, or a supplementary spec, etc.

Inspection may be done in any manner jointly agreed upon previously. Some of the more common types of agreements are: final inspection and acceptance at the vendor's plant, final inspection and acceptance by buyer or vendor certification.

Perhaps even more important than where the inspection takes place is the type of inspection to be performed. Basically, there are two methods of inspection, inspection by attributes, where conformance to a characteristic of the unit being inspected is judged only by whether it is within or outside its prescribed requirement, and inspection by variables, where conformance to the requirement is judged from the actual measured values which are also summarized or plotted for use in engineering analysis or process control.

The acceptance inspection of material produced in volume divides into two broad classes, detailed inspection and acceptance sampling, either of which may be made by attributes or variables.

Clear definition of the sampling needs will indicate the preferred type of sampling plan. Details of sampling can then be determined from the magnitude of the defect content and the level of statistical proof required. Clear definitions, classification of defects, logic, statistical analysis, and sampling tables are the major tools needed.

*Abstracted from RETMA Quality Acceptance Bulletin No. 1, entitled "Acceptance Agreements," Bulletin No. 2, entitled "Acceptable Quality Levels and How They are Set Up," and Bulletin No. 3, entitled "Introduction to Sampling." Copies of each of these Bulletins and others to be issued are available from the Engineering Department, Radio-Electronics-Television Manufacturers Association, 11 W. 42nd St., New York 36, N.Y., for 25 cents each.*



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Use the world's smallest, lightest, most reliable, magnetically regulated power supplies — now available from Engineered Magnetics, each one JAN approved and each one rugged enough to withstand the great extremes demanded by modern missile and aircraft instrumentation. MAGNAPACK miniaturized power supplies are hermetically sealed units with no moving parts or filaments, eliminating maintenance and assuring stability under adverse conditions of shock and vibration.

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# Ferromagnetic Core Circuitry in Digital Computers

**D**EVELOPMENTS of components and circuits intended primarily for inclusion in digital computers, has focused much attention on the possibility of utilizing a square hysteresis-loop, ferromagnetic toroidal core as the primary logical element in these computational circuits.

In this paper, the data gathered through a survey plus the author's own work in the field, has been set down to explain the use of magnetic core logical circuitry in the digital computation field.

## Characteristics of Square Hysteresis-Loop Magnetic Material

Fig. 1 shows the B-H curve of a typical square hysteresis-loop ferromagnetic material. If the material is magnetized at the point on the loop marked  $+B_r$ , and is subjected to a negative magnetizing force of value  $-H_m$ , it will traverse the path in the direction of the arrows to the point of 0. There will be a large change of flux. Then, when the magnetizing force is

withdrawn, the material will return to the point shown by the  $-B_r$ . If, on the other hand, the material is at the point  $-B_r$ , before the magnetizing force  $-H_m$  is applied, then upon the application of  $-H_m$ , there will be only the slight flux change, and the ferromagnet will then return to  $-B_r$ . These two states, corresponding to  $+B_r$  and  $-B_r$ , can be used to represent the binary states ONE and ZERO respectively.

All that is needed to detect the condition of the material is a winding which links the flux. Then if the substance contains a ONE when it is driven to 0, there will be a large flux change and a corresponding large voltage across the winding, whereas if it contains a ZERO then only a small voltage appears across the winding.

In the operation of the Wang-Woo delay line, Fig. 2, an information pulse would be inserted into core 1, then an advance pulse would transfer it out of core 1 into core 2 to make room for the next information input. A second advance pulse would transfer it from

core 2 to core 3, and core 1 would be ready to receive the next bit of information. The advance pulses would continue cyclically and when the first bit of information reached the end of the delay line it would be read out. If the advance pulses were halted with the information still in the delay line, information would remain there indefinitely or until the advance pulses recommenced. If the output of the delay line was connected back to the input, then the information would recirculate and be available for sampling at any desired time, much on the order of the magnetic drum or tape storage.

## Two Core Per Bit Magnetic Shift Registers

An important advance in the design of magnetic shifting registers came in the form of the two-core-per-bit transfer loops. These loops eliminated the extra core shown in the earlier three core per bit forms and, at first, utilized a shunt diode to short out the

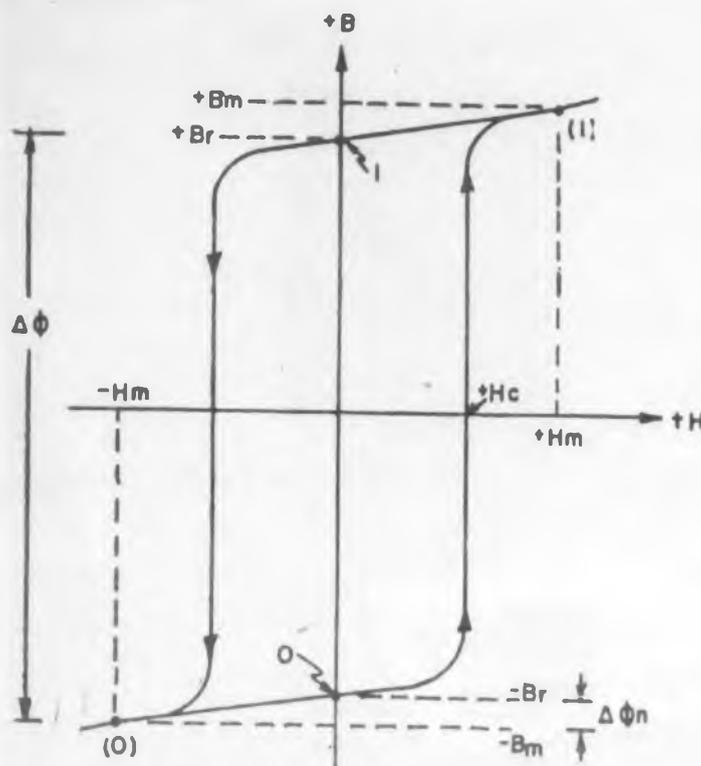


Fig. 1. Hysteresis loop of ferromagnetic core material.

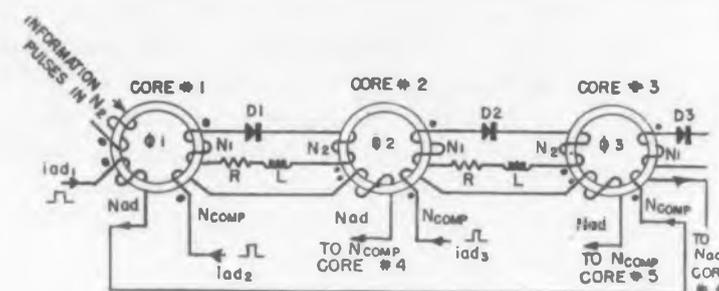


Fig. 2. Wang-Woo magnetic delay line.

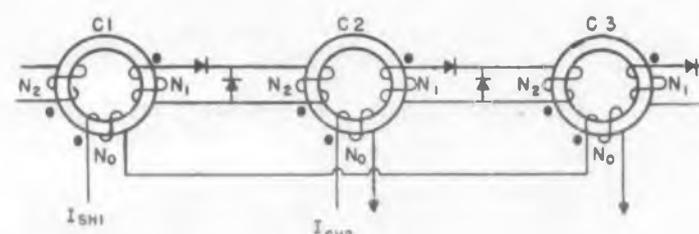


Fig. 3. Shunt diode, two core per bit shift register.

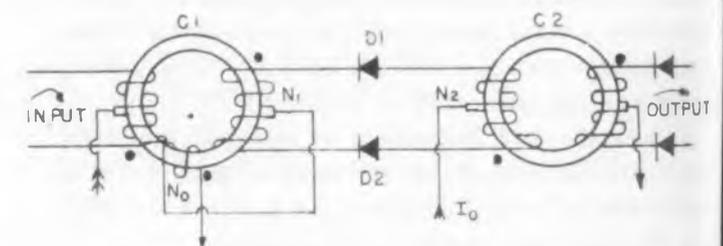


Fig. 4. Biased diode transfer loop.

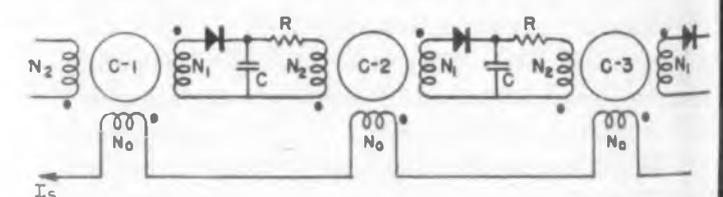


Fig. 5. One core per bit transfer loop.

current which would tend to transfer information backwards. A circuit of this type is shown in Fig. 3. The two-core-per-bit or double line registers are superior to previous forms in speed of operation. These registers have been run at information rates above 250 kc.

With the development of production type germanium diodes, the selenium diodes were replaced and frequency began to increase. It was discovered that by utilizing proper design techniques, the number of turns on various windings about the transfer loop could be so adjusted as to make the shunt diode unnecessary.

All magnetic core logical elements with several output windings per core generated output voltages on each of the output windings when the core was interrogated by a reading pulse. It was not possible, using these elements, to read out information into separate, specified circuits from the same core at different times.

Gated diode circuits are capable of effecting a conditional transfer into one of the several specified output circuits about an element, or of the allowing transfer out of an element only upon a particular condition, regardless of the polarity or amplitude of the input signals. They achieve this conditional transfer type of operation through the placement of two diodes in the transfer loop between the elements, Fig. 4. The diodes are arranged in such a way that the cores are linked electrically only when a current generated by some external source is passed through the loop.

#### One Core Per Bit Magnetic Shift Registers

In the shift registers described so far, the information and storage transfer has always required use of two or more cores per bit. At any instant, one core could be considered a permanent storage and the other a temporary storage. Two separate phases of advance pulses were required. By utilizing the temporary storage properties of a charged capacitor, one core per bit operation has been achieved. In this scheme, Fig. 5, a single advance pulse line is used to saturate all cores in the magnetic shift register simultaneously to the ZERO state. Those cores which were previously in the ONE state charge their associated condensers through a diode. After the advance pulse has ended and the condensers have been fully charged, they discharge through the series resistors and input windings of the immediately following stages to read ONES into the cores. The information is advanced one stage with each application of the advance pulse. This means one core and one diode per bit of information stored.

This report also discusses ferromagnetic core logical systems. Included in the discussion are gates, timing pulses, adders, magnetic decision elements and transistor core circuits. *Abstracted from PB 111954 Ferromagnetic Core Logical Circuitry and Its Applications in Digital Computers. A. J. Lincoln, Ballistic Research Lab., Aug. 1955.*

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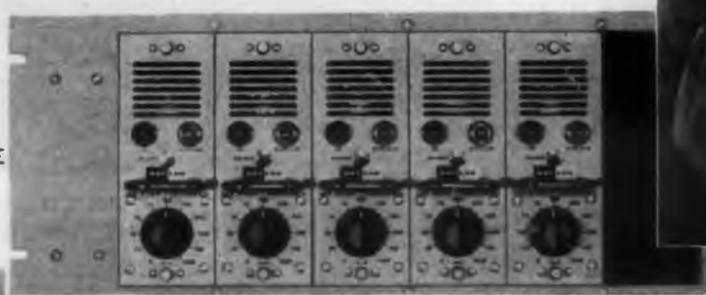
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The KAY LAB Model 111 amplifier provides maximum stability and the lowest drift of any commercially available broadband d-c amplifier. It is the end result of years of research in the field of chopper stabilized broadband d-c amplifiers. Thousands of KAY LAB amplifiers are in daily use.

The Model 111 incorporates KAY LAB's proven chopper amplifier circuitry and provides ten extremely precise, feedback controlled gain ranges. Several feedback loops assure high accuracy, stability, and uniform frequency response. The completely new and unique circuit provides rapid recovery from severe overloading and unsurpassed dynamic performance — unaffected by load or gain changes.

The Model 111 is available in a single-unit cabinet or in a six-unit rack-mountable module. The amplifiers are extremely compact, the six-unit module occupies only a 19-inch rack width.

APPLICATIONS: The Model 111 is ideal for permanent low level d-c instrumentation, telemetering, or as a strain gage amplifier, transducer amplifier, scope preamplifier, recorder driver amplifier, or general purpose laboratory amplifier.

**SPECIFICATIONS**

Gain	0, 20, 30, 50, 70, 100, 200, 300, 500, 700, 1000
Gain Accuracy	± 1% DC to 2 KC
Input Impedance	100,000 Ω
Output Capability at DC	0 to ± 35 V where $R_L > 1000 \Omega$ 0 to ± 40 MA where $R_L$ is 10 to 400 Ω
Output Impedance	Less than 1 Ω in series with 25 μh
Equivalent Input Drift	± 2 μv with regulated line
Equivalent Input Noise	0 to 3 cps, less than 5 μv peak to peak 0 to 750 cps, less than 5 μv RMS 0 to 50 kc, less than 12 μv RMS
Chopper Intermodulation	Less than 0.1%
Linearity	Better than 0.1% to 2 KC
Frequency Response	± 3% (0.3 db) DC to 10 KC, less than 3 db down at 40 KC

Power Requirements:	
Amplifier	117 V — 60 cycles — 70 VA
Cabinet	117 V — 60 cycles — 15 VA
6 Unit Rack Adaptor	117 V — 60 cycles — 45 VA
Dimensions: Amplifier Unit	2 1/2" wide, 7 1/2" high, 14 1/2" deep
Rack Adaptor for 6 Units	19" wide, 8 3/4" high, 18 1/4" deep
Net Weight — Amplifier	11 pounds
PRICE: Amplifier Unit	\$550.00
19-inch Rack Adaptor for 6 amplifier (with fans and connectors)	200.00
Cabinet for single amplifier (with fan and connector)	is available.

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**Standards and Specs****Sherman H. Hubelbank**

This department surveys new issues, revisions, and amendments, covering military and industry standards and specifications. Our sources of information include the Armed Services Electro-Standards Agency (ASESA), the cumulative indexes to Military Specifications, Vols. II, IV, American Standards Association (ASA) and other standards societies.

**Aircraft Electronics**

ANA BULLETIN No. 400g, APPLICABLE DOCUMENTS FOR AIRCRAFT ELECTRONIC EQUIPMENT, 1 MARCH 1956

The latest effective issue of specs, standards, drawings, and publications to be used in the design and construction of airborne electronic equipment are listed by this Air Force-Navy Aeronautical Bulletin. The use of this list is governed by MIL-E-5400.

MIL-E-5400 (ASG), GENERAL SPECIFICATION FOR AIRCRAFT ELECTRONIC EQUIPMENT, NOTICE 1, 10 FEBRUARY 1956

The general requirements for the design and manufacture of airborne electronic equipment for operation primarily in piloted aircraft are covered in this spec. The detail performance and test requirements for a particular equipment are still specified in the detail spec for the equipment. Unless otherwise stated in equipment specs, requisitions, drawings, contracts, or orders, all equipment shall be designed for 50,000 feet altitude and continuous sea level operation over the temperature range of  $-55^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$ .

**Audio Cable Insulation**

MIL-C-3883, AMENDMENT 1, CORD, ELECTRICAL (AUDIO FREQUENCY), 20 JUNE 1956

All references to the properties, test requirements, and test methods relating to insulating and jacketing compounds, formerly described in the body of the spec have been deleted and replaced by references to MIL-I-3930, Insulating and Jacketing Compounds, Electrical (for Cable, Cord, and Wire). Three spec sheets have been revised to specify the particular type of Buna-S material, as indicated in MIL-I-3930, for the insulation and shield jacket.

**Transformers**

MIL-T-27A, SUPPLEMENT 1B, TRANSFORMERS AND INDUCTORS (AUDIO, POWER, AND PULSE), 28 JUNE 1956

Supplement 1B includes additional "MS" Military Standards covering nine different types of audio-frequency transformers.

## Semiconductor Symbols

56 IRE 28. S1, LETTER SYMBOLS FOR SEMICONDUCTOR DEVICES, JULY 1956

A uniform system of letter symbols for electrical quantities and parameters as applied to semiconductor devices is provided for by this standard. This standard is supplementary to the IRE Standards on Abbreviations, Graphical Symbols, Letter Symbols, and Mathematical Signs—1948, Section I. The usage conforms to Section 101, General Principles of Letter Symbol Standardization. The standard has been divided into three sections: 1) electrical quantities, dealing primarily with voltage, current, and time quantities; 2) electrical parameters, dealing with the relationship between specific electrical quantities; and 3) a list of letter symbols in alphabetical order. Copies of this standard may be obtained from the Institute of Radio Engineers, 1 E. 79th St., New York 21, N.Y. for \$0.50 per copy.

## Electrical Cable Insulation

MIL-C-3884, AMENDMENT 1, CORD, ELECTRICAL (SHORT LAY), 20 JUNE 1956

All references to the properties, test requirements, and test methods relating to insulating and jacketing compounds, formerly described in the body of the spec, have been deleted and replaced by references to MIL-I-3930, Insulating and Jacketing Compounds, Electrical (for Cable, Cord, and Wire). The typographical error concerning the procedure for breaking the load of the core has been corrected. Three spec sheets have been revised to specify the particular type of Buna-S material, as indicated in MIL-I-3930, for the insulation and shield jacket.

## Receiver Requirements

Recommended Methods of Measurement on receivers for Frequency Modulation Transmission was authorized for publication by the International Electrotechnical Commission as the result of the ten-day conference held June 29 through July 6, 1956 in Munich, Germany. A document on radiation measurements was accepted for circulation. The committees acted in favor of a document on the method for testing for volume and surface resistivities of insulating materials. A publication on primary cells and batteries was also approved for publication. The 1957 meeting of the IEC will be held in Moscow, where delegates will be the guests of the U.S.S.R. National Committee of IEC from July 2-12. The International Electrotechnical Commission, which develops standards in the field of electrical engineering and communications, is a federation of the national committees of 32 countries. The United States National Committee of IEC is an arm of the American Standards Association.

# About a Sawtooth, Clamping and your Efficiency...

**Let's look at it this way**—What features should an instrument incorporate to make your job easier, help prevent costly mistakes? Take the case of the new PRD Klystron Power Supply. Should we incorporate a sawtooth rather than a sine wave modulation? It's easier to put in a sine wave. However, a sawtooth has the definite advantage of eliminating phasing and blanking problems when the frequency response of a transmission device is to be studied. So, in goes the sawtooth. It's easy enough to get hold of some sine wave modulation which can be applied through the external modulation input.

**As for preventing mistakes**—consider switching from cw to square wave modulation. Suppose you forget to readjust the reflector voltage . . . Sure, you'll catch the mistake later, but time is lost. The new PRD Klystron Power Supply has an electronic clamping circuit which locks the top of the square wave to the previously chosen reflector voltage. No readjustments to think about, no mistakes.

**Want to modulate with pulses**—use the external input. The rise time degradation of your pulses will be less than .1 microsecond!

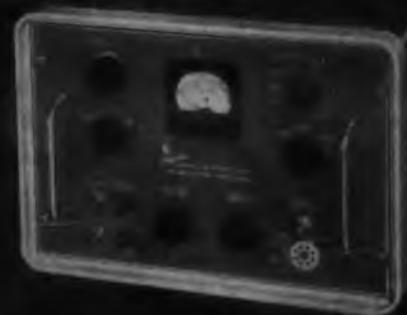
**Another point, good regulation!** Here's an example: a  $\pm 10\%$  line change or any load change will cause a reflector voltage change of only  $\pm 0.1\%$ .

Compare . . . chances are that you'll send in your order for the PRD Type 809, too.

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CIRCLE 380 ON READER-SERVICE CARD FOR MORE INFORMATION

## TEMPERATURE- RISE PROBLEMS?

The manuals and data sheets of a number of leading electron tube manufacturers suggest Tempilaq° as a convenient means of determining operating temperature characteristics.

Some of the problems in the electronic field for which Tempilaq° has been found very useful are:

- Monitoring metal-to-glass seal temperature of electronic tubes.
- Safeguarding television camera tubes against overheating.
- Checking baking temperature of television picture tube bulbs.
- Monitoring temperature rise of transmitter tubes.
- Finding causes for tube failure.
- Checking temperature rise of rheostats.
- Testing current carried by resistors.
- Determining operating temperatures of industrial x-ray machines.
- Signaling overheating of power switches and electrical apparatus generally.

Let us cite some typical applications of Tempilaq° for customers' letters:

<sup>1</sup> "We have used Tempilaq° during the development of a transmitter. Cooling of power tubes, inductors, and other components under operating conditions needed to be carefully evaluated. Tempilaq° temperature indicators proved to be a practical method of checking the operating temperature of these critical items."

<sup>2</sup> "Tempilaq° was used to determine the maximum operating temperature of the metal-to-glass seal in a vacuum tube (Type 2C39A) operating in an ultra high frequency coaxial cavity circuit.

The manufacturer's maximum recommended operating temperature of this seal was 350°F. As insertion of an external thermocouple to measure the temperature would have disturbed the electrical operation of the circuit, we used your Tempilaq° instead to fix the maximum temperature range reached by this seal. This test gave us assurance that we were adequately cooling the tube and keeping it within manufacturer's ratings."

<sup>3</sup> ". . . This then was the problem—to find a radiator which was light, small, and would still dissipate a quantity of heat sufficient to keep the x-ray tube at normal operating temperatures. Temperature

measurements of the radiator by direct reading instruments was impossible because of the high voltage (125KV to ground) present on the radiator.

. . . Tempilaq° was the answer. Tempilaq° was painted on the front and back surfaces of the radiators in lines running outward from the center. Each succeeding radial line of Tempilaq° around the radiator's surface had a higher melting temperature. The ranges used were 125° to 250°. By observing the highest temperature line disappear, for any given operating point of the machine, we were able to tell the highest temperature the radiator had reached.

By correlating the time lapse of any one operational setting of the machine and noting the highest melted line as well as the lowest un-melted line, we were able to tell within a few degrees the equilibrium temperatures of the radiators. The experiment proved to be quite to our satisfaction."

Tempilaq° consists of materials of calibrated melting points, suspended in volatile, non-flammable liquid. There are some sixty different Tempilaqs° covering the range from 113°F to 2000°F, each indicating a specific temperature, with an accuracy of plus or minus 1%.

Tempilaq° may be applied by daubing, brushing, dipping or spraying, and can be thinned to required consistency with Tempilaq° Thinner. Tempilaq° dries in a few seconds after application to a dull, opaque film which retains its mat appearance until its temperature rating is reached, when it liquefies sharply. On subsequent cooling the Tempilaq° film solidifies with a glossy appearance which clearly shows that melting had occurred.

A thin temperature-sensitive film can be applied by spraying well diluted Tempilaq° on with an airbrush. A fine haze will often suffice to provide a visible coating on clear glass or on other polished surfaces. Melting can be recognized by the developed transparency which lets the background show through. This "fine haze" technique is recommended for application on clear glass subjected to radiant heat, in preference to using a heavy coat of Tempilaq°. The latter would absorb radiant heat and cause an abnormal temperature rise in the covered area. The use of a light, almost transparent film of Tempilaq° minimizes such localized temperature gradients.

Half-ounce samples of Tempilaq° can be obtained by writing to TEMPILAQ° CORPORATION at 132 West 22nd Street, New York 11, N. Y. Be sure to specify the temperature rating of interest to you and whether Fahrenheit or Celsius.



## ASA Standards

ASA has recently announced the approval of the following new standards:

C6.1-1956, TERMINAL MARKINGS FOR ELECTRICAL APPARATUS

C33.3-1956, SAFETY FOR CORD SETS AND POWER-SUPPLY CORDS

C33.4-1956, SAFETY FOR SPECIALTY TRANSFORMERS

C033.5-1956, SAFETY FOR WIRE CONNECTORS AND SOLDERING LUGS

## ASA Membership Directory

The 115 national technical societies, trade associations, and public interest groups, and the 2300 companies which are affiliated with ASA are listed in a new 63-page booklet, entitled "Directory of the Members of the American Standards Association." It also names the officers and the Board of Directors of the Association. The booklet also gives the state and city governments, colleges and universities, and various individuals affiliated with ASA. Copies of the booklet are free upon request from Dept. PR, American Standards Association, 70 E. 45 St., New York 17, N. Y.

## ASA Standards Information

The three ways that standards become nationally accepted and approved as American Standards are described in a 19 page booklet issued by ASA. It tells who makes these standards and why, and who uses them. The booklet also explains who ASA is, how it guards the democratic processes through which American Standards are developed, and how it operates impartially for the manufacturer, the consumer and the general public. Included in this booklet is a glossary of terms that are likely to be met when discussing or formulating standards under the procedures of ASA. Copies of this booklet, entitled "How American Standards Are Made," may be obtained without charge by writing Dept. PR, American Standards Association, 70 E. 45 St., New York 17, N. Y.

## Resistors

MIL-R-26C, RESISTORS, FIXED, WIREWOUND (POWER TYPE), 28 JUNE 1956

All 31 spec sheets formerly included with MIL-R-26B have been cancelled. The following 17 styles of resistors have been retained: RW20, RW21, RW22, RW23, RW24, RW29, RW30, RW31, RW32, RW33, RW35, RW36, RW37, RW38, RW47, RW55, and RW56. The requirements for these styles now appear as figures in the body of the spec. The styles have been deleted in the newly issued spec.

<sup>1</sup> Stromberg-Carlson Company, a Division of General Dynamics Corporation, Rochester 3, New York.

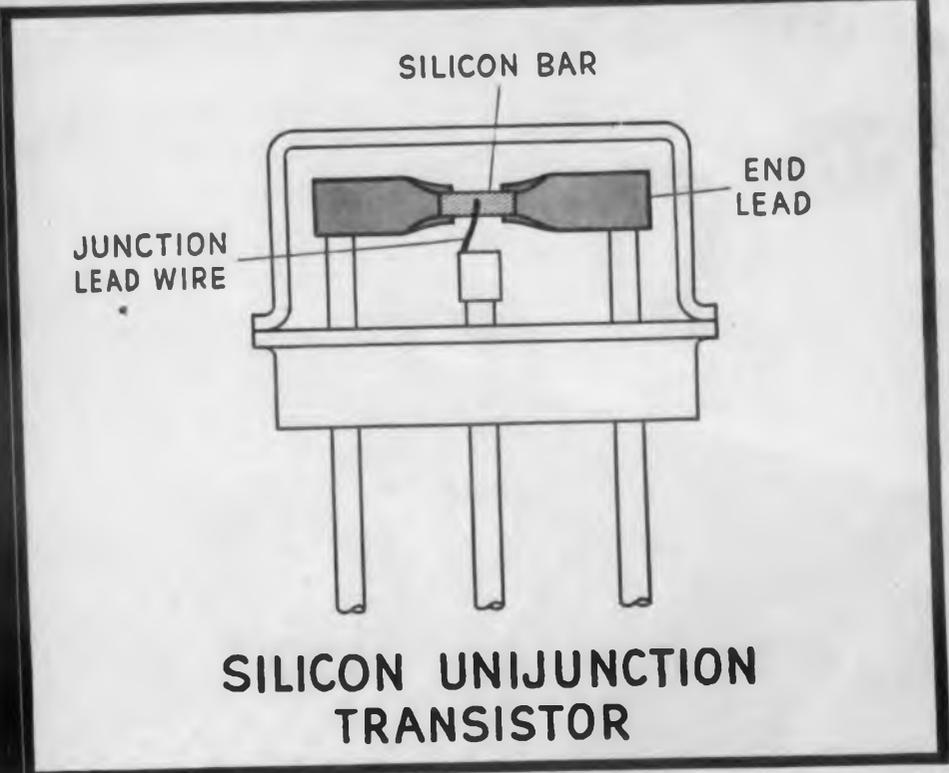
<sup>2</sup> Adler Communications Laboratories, 1 Le Fevre Lane, New Rochelle, N. Y.

<sup>3</sup> Industrial X-Ray Engineers, 115 Belmont Avenue No., Seattle 2, Wash.

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September 15, 1956

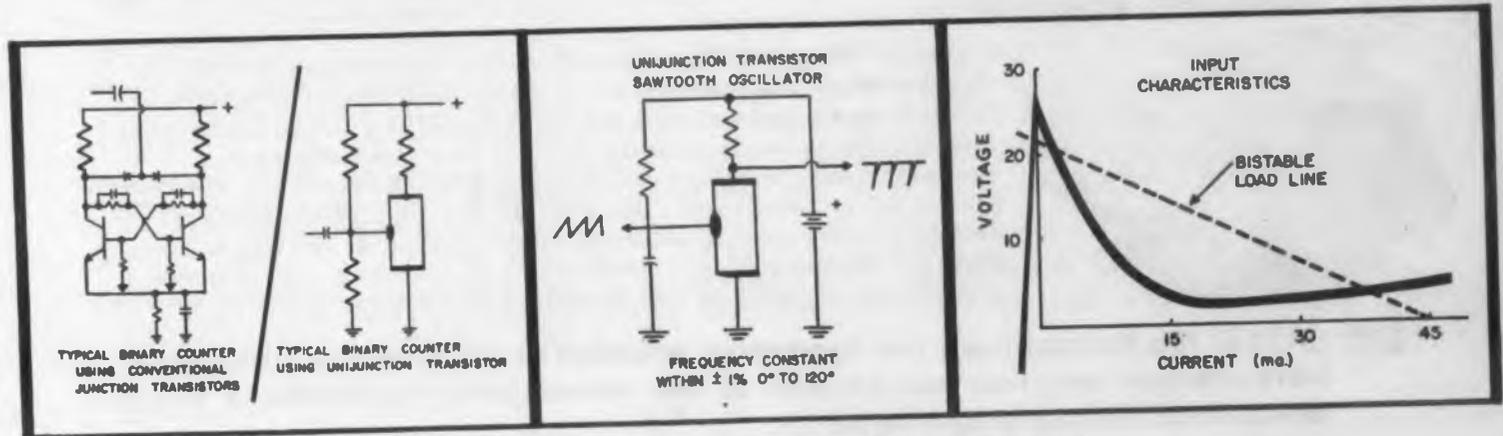
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Chicago Magnetic Controls	65
Chicago Standard Transformer	97
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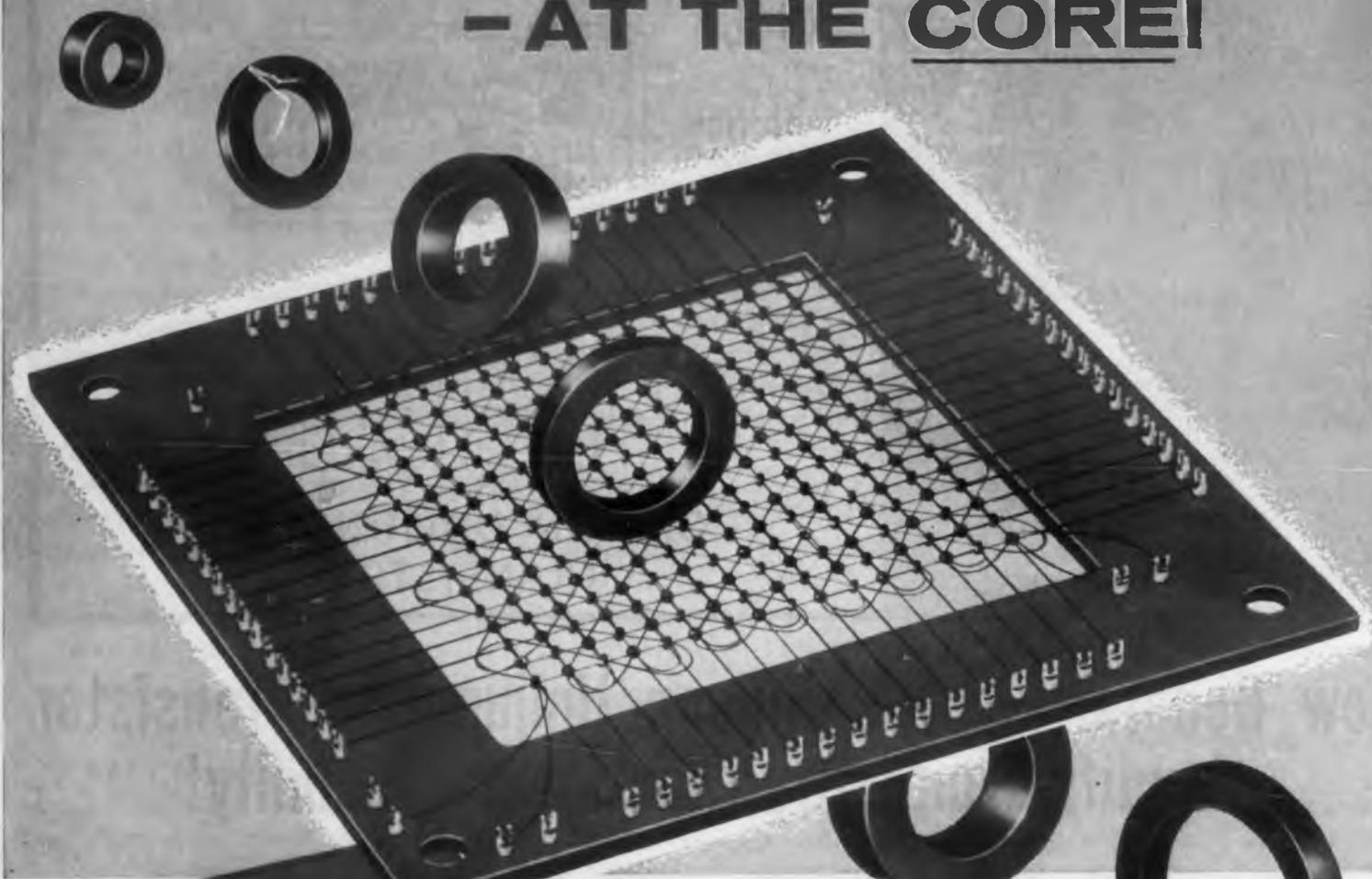


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